PROCEEDINGS

OF THE

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VOL. VI.

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VOLUME VI.

1853-1857.

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VOLUME VI.

THE ACADEMY *desire it to be understood, that they are not answerable for any opinion, representation of facts, or train of reasoning, that may appear in the following Papers. The Authors of the several Essays are alone responsible for their contents.*

THE

ROYAL IRISH ACADEMY.

MARCH 16, 1855.

Patroness.

HER MOST SACRED MAJESTY THE QUEEN.

Visitor.

HIS EXCELLENCY THE LORD LIEUTENANT OF IRELAND.

President.

REV. THOMAS ROMNEY ROBINSON, D. D.

Elected 16th March, 1851.

Vice-Presidents.

(Nominated by the President.)

March 16, 1852.	COLONEL THOMAS A. LARCOM, R. E., F. R. S.
March 16, 1853.	GEORGE PETRIE, LL. D.
March 16, 1854.	REV. CHARLES GRAVES, D. D.
March 16, 1855.	SIR ROBERT KANE, M. D., F. R. S.

COUNCIL.

Committee of Science.

Elected.	
March 16, 1838.	ROBERT BALL, LL. D.
March 16, 1840.	SIR ROBERT KANE, M. D., F. R. S.
March 16, 1844.	GEORGE J. ALLMAN, M. D., F. R. S.
March 16, 1846.	SIR WILLIAM R. HAMILTON, LL. D.
Nov. 30, 1847.	REV. SAMUEL HAUGHTON, A. M.
March 15, 1851.	REV. HUMPHREY LLOYD, D. D., F. R. S.
March 16, 1855.	REV. GEORGE SALMON, A. M.

Committee of Polite Literature.

Elected.	
March 16, 1821.	Rev. William H. Drummond, D. D.
March 16, 1843.	John Anster, LL. D.
Feb. 12, 1844.	Rev. Charles Graves, D. D.
March 16, 1844.	Rev. Samuel Butcher, D. D.
March 15, 1851.	Rev. John H. Jellett, A. M.
March 15, 1851.	Digby P. Starkey, Esq.
March 16, 1855.	John F. Waller, LL. D.

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March 16, 1829.	George Petrie, LL. D.
March 16, 1837.	Rev. James H. Todd, D. D.
March 16, 1849.	Aquilla Smith, M. D.
March 15, 1851.	Earl of Dunraven, F. R. S.
March 16, 1852.	Colonel Thomas A. Larcom, R. E., F. R. S.
March 16, 1853.	Lord Talbot de Malahide.
March 16, 1855.	William R. Wilde, Esq.

Officers.

Treasurer—Robert Ball, LL. D.
Secretary of the Academy—Rev. James H. Todd, D. D.
Secretary of Council—Rev. John H. Jellett, A. M.
Secretary of Foreign Correspondence—Rev. Samuel Butcher, D. D.
Librarian—Rev. William H. Drummond, D. D.
Clerk and Assistant Librarian—Edward Clibborn.

HONORARY MEMBERS.

Elected.	
Aug. 2, 1849.	His Royal Highness Prince Albert.
	Section of Science.
Nov. 30, 1832.	Airy, George Biddell, M. A., F. R. S., &c., Astronomer Royal. *Greenwich.*
Nov. 30, 1826.	Babbage, Charles, M. A., F. R. S., &c. *London.*
Nov. 30, 1850.	Bache, Alexander D. *Washington, D. C., United States.*
Nov. 30, 1852.	Beaumont, Elie de. *Paris.*
Oct. 28, 1822.	Brewster, Sir David, K. H., LL. D., F. R. S., &c. *St. Andrews.*
Jan. 25, 1836.	Brisbane, Lieut-General Sir Thomas Mac Dougal, K. C. B., F. R. S., Pres. R. S. E., &c. *Kelso.*
May 22, 1826.	Brown, Robert, D. C. L., F. R. S., &c. *British Museum, London.*
Nov. 30, 1852.	Cauchy, Augustin Louis. *Paris.*
Jan. 25, 1836.	Daubeny, Charles Giles Bridle, M. D., F. R. S., &c. *Oxford.*
Mar. 16, 1841.	Dumas, Jean Baptiste. *Paris.*
Mar. 16, 1820.	Dupin, Charles. *Paris.*
June 27, 1825.	Greville, R. K., LL. D. *Edinburgh.*
Jan. 23, 1826.	Herschel, Sir John Frederick William, Bart. D. C. L., F. R. S., &c. *Hawkhurst.*
June 27, 1825.	Hooker, Sir William Jackson, K.H., LL.D., F.R.S.
Nov. 30, 1849.	Humboldt, Alexander Von. *Berlin.*
June 26, 1837.	Liebig, Justus. *Giessen.*
Jan. 25, 1836.	Murchison, Sir Roderick Impey, Knt., F.R.S., &c. *London.*

Elected.	
Nov. 29, 1828.	Parry, Sir William Edward, Knt., D. C. L., Rear-Admiral, F. R. S., &c. *London.*
Mar. 16, 1841.	Quetelet, Adolphe Jacques. *Brussels.*
Nov. 30, 1852.	Regnault, Victor. *Paris.*
Jan. 25, 1836.	Rennie, George, Esq., F. R. S., &c. *London.*
Jan. 25, 1835.	Sedgwick, Rev. Adam, M. A., F. R. S., &c. *Cambridge.*
May 26, 1834.	Somerville, Mrs. Mary. *Chelsea.*
Mar. 16, 1827.	South, Sir James, Knt., F. R. S., &c. *Kensington.*
Jan. 25, 1836.	Sykes, Lieut-Col. William Henry, F. R. S., &c. *London.*
Mar. 16, 1854.	Vrolik, Wm. *Amsterdam.*
Mar. 16, 1842.	Wheatstone, Charles, Esq., F. R. S., &c. *London.*
Jan. 25, 1836.	Whewell, Rev. William, D. D., F. R. S., &c., Master of Trinity College, Cambridge. *Cambridge.*

SECTION OF POLITE LITERATURE.

Nov. 30, 1850.	Boeck, Augustus. *Berlin.*
Nov. 30, 1849.	Bopp, Franz. *Berlin.*
Mar. 16, 1835.	Combe, George, Esq. *Edinburgh.*
Nov. 30, 1850.	Cousin, Victor. *Paris.*
Nov. 30, 1849.	Grimm, Jacob. *Berlin.*
Nov. 30, 1849.	Guizot, Françoise Pierre Guillaume. *Paris.*
Jan. 25, 1836.	Harcourt, Rev. William Vernon, M. A., F. R. S. &c. *York.*
Nov. 30, 1835.	Hobhouse, Right Hon. Henry. *Hadspur House, Somersetshire.*
Nov. 30, 1850.	Irving, Washington. *Sunnyside, Dobb's-Ferry, New York.*
Nov. 30, 1849.	Lepsius, Richard. *Berlin.*
Nov. 30, 1852.	Macaulay, Right Hon. Thomas B. *London.*
July 25, 1830.	Macloughlin, David, M. D. *Paris.*
Nov. 30, 1852.	Prescott, William H., Esq. *United States.*
Nov. 30, 1849.	Ranke, Leopold. *Berlin.*
Nov. 30, 1850.	Thiers, A. *Paris.*

Section of Antiquities.

Elected.	
Nov. 30, 1848.	Botta, P. E. *Paris.*
Apr. 24, 1826.	Brewer, James N., Esq.
Nov. 30, 1848.	Bunsen, Chevalier C. C. J. *Berlin.*
May 27, 1833.	Cooper, Charles Purton, LL. D., F. R. S., F. S. A., &c. *London.*
May 15, 1835.	Donop, Baron. *Saxe Meiningen.*
Nov. 30, 1832.	Ellis, Rt. Hon. Sir Henry, K.H., Sec. S.A., F.R.S., &c. *London.*
Nov. 30, 1832.	Forshall, Rev. Josiah, M. A., F. R. S., F. S. A., &c. *London.*
Mar. 16, 1841.	Halliwell, James Orchard, Esq., F. R. S., F. S. A., &c. *Brixton Hill, Surrey.*
Nov. 30, 1832.	Madden, Sir Frederick, K. H., F. R. S., F. S. A., &c. *London.*
Mar. 16, 1854.	Mauray, M. Alfred de. *Paris.*
Nov. 30, 1850.	Petit-Radel, L. C. F. *Paris.*
Dec. 10, 1827.	Rafn, C. C. *Copenhagen.*
Nov. 13, 1837.	Smyth, William Henry, Rear-Admiral, F. R. S., D. C. L., F. S. A., &c. *St. John's Lodge, near Aylesbury, and Athenæum Club.*
Nov. 30, 1848.	Thomsen, C. J. *Copenhagen.*

MEMBERS.

The Names of Life Members are marked with an Asterisk.

Elected.

Apr. 10, 1843. *Allman, George James, M. D. T. C. D., F. R. S., Professor of Botany, T. C. D. *Blackrock.*

Jan. 14, 1839. *Andrews, Thomas, M. D., F. R. S., Vice-President and Professor of Chemistry, Q. C., *Belfast.*

Apr. 28, 1828. *Apjohn, James, M. D. T. C. D., F. R. S., Professor of Chemistry and Mineralogy, T.C.D. 32, *Baggot-street, Lower.*

Mar. 16, 1815. *Ashburner, John, M. D. 7, *Hyde Park Place, London.*

May 8, 1843. Abeltshauser, Rev. I. George, LL. D., Queen's Professor of French and German, T. C. D. 32, *Rutland-square, West.*

Apr. 9, 1838. Adams, Robert, M. D. T. C. D. 22, *Stephen's-green, North.*

Apr. 13, 1846. Alcorn, Rev. John, A. M. *Marlfield, Clonmel.*

May 11, 1846. Aldridge, John, M. D. 3, *Sackville-street, Lower.*

Jan. 10, 1842. Andrews, William, Esq. 21, *Mountpleasant-square, West.*

Apr. 8, 1850. Angeli, Signor Basilio, Queen's Professor of Italian and Spanish, T. C. D. 17, *College.*

Feb. 12, 1838. Anster, John, LL. D., Regius Professor of Civil Law, T. C. D. 5, *Lower Gloucester-street.*

Apr. 10, 1837. Armstrong, William, Esq., C. E. 25, *Henry-street.*

Jan. 26, 1818. *Baillie, Rev. J. Kennedy, D. D. *Stewartstown.*

Jan. 28, 1822. *Bald, William, Esq., F. R. S. E.

Elected.

Feb. 23, 1834. *Ball, Robert, LL. D., Director of the Museum, T.C.D.; Secretary to the Queen's University; Secretary of the Royal Zoological Society of Ireland; President of the Zoological Association, T.C.D.; V. P. Geological Society of Dublin; Local Sec. Botanical Society of Edinburgh, and of the Ray Society, &c.—TREASURER. 3, *Granby-row.*

Apr. 13, 1840. *Ball, John, Esq., M. P. 85, *Stephen's green, South.*

Jan. 10, 1842. *Banks, John T., M. D. T. C. D., King's Professor of the Practice of Medicine, T. C. D. 29, *Merrion-street, Upper.*

Apr. 14, 1851. *Barker, John B., M.B.T.C.D. 48, *Waterloo-road.*

Apr. 24, 1809. *Bateson, Sir Robert, Bart. *Belvoir Park, Belfast.*

Oct. 22, 1832. *Beaufort, Sir Francis, Admiral, K. C. B., D. C. L., F. R. S., F. R. A. S., Corr. Inst., France, &c. 11, *Gloucester-place, Portman-square, London.*

Nov. 30, 1825. *Benson, Charles, A. M., M. D. T. C. D. President, Royal College of Surgeons. 12, *Fitzwilliam-square, West.*

Nov. 30, 1836. *Bergin, Thomas F., Esq. 49, *Westland-row.*

Jan. 8, 1849. *Bewglass, Rev. James, LL. D. *Wakefield, Yorkshire.*

Jan. 9, 1843. *Blacker, Stewart, Esq. 20, *Gardiner's-place.*

Nov. 30, 1836. *Bolton, William Edward, Esq. 3, *James's-terrace, Malahide.*

Apr. 12, 1841. *Botfield, Beriah, Esq., F. R. S. 9, *Strattan-street, London.*

Feb. 12, 1838. *Boyle, Alexander, Esq. *Belvue Park, Dalkey.*

Feb. 27, 1832. *Brady, Right Hon. Maziere, A. B., Lord High Chancellor of Ireland. *Hazelbrook, Roundtown, and* 26, *Pembroke-street, Upper.*

Nov. 12, 1838. *Bruce, Halliday, Esq. *Glenageary House, Dalkey.*

Jan. 10, 1842. *Butcher, Rev. Samuel, D. D., Regius Professor of Divinity, T. C. D.—SECRETARY OF FOREIGN CORRESPONDENCE. *College, and* 13, *Fitzwilliam-square, West.*

Apr. 12, 1847. Baker, A. Whyte, Esq. *Ballaghtobin House, Callan.*

Jan. 9, 1837. Barker, Francis, M. D. T. C. D. 26, *Baggot-st., Lr.*

Elected.	
Jan. 25, 1836.	Barker, William, M. D. T. C. D., Vice-President, King and Queen's College. 21, *Hatch-street.*
Feb. 10, 1851.	Barker, William Oliver, M. D. T. C. D. 6, *Gardiner's-row.*
May 10, 1847.	Barnes, Edward, Esq., C. E. *Ballymurtagh Lodge, Ovoca.*
Jan. 9, 1837.	Barrington, Sir Matthew, Bart. 50, *Stephen's-green, East.*
Apr. 10, 1848.	Barry, Michael, Esq., Professor of English Law, Q. C., Cork. 75, *Gardiner-street, Lower.*
June 8, 1846.	Beasley, Thomas John, Esq., A. M. 11, *Stephen's-green, North, and Brighton Cottage, Rathgar.*
June 24, 1833.	Beatty, Thomas E., M. D., Professor of Midwifery, R. C. S. 18, *Merrion-square, North.*
Jan. 11, 1841.	Beauchamp, Henry C., M. B. T. C. D. 115, *Baggot-street, Lower.*
Jan. 8, 1849.	Bell, John, Esq., F. S. A. E. *Dungannon.*
Apr. 13, 1846.	Bevan, Philip, M. D. T. C. D., F. R. C. S. L. 21, *Baggot-street, Lower.*
Dec. 11, 1843.	Bewley, Edward, M. D. *Leighsbrook, Navan.*
Jan. 8, 1855.	Blackburne, Right Hon. Francis, LL. D. *The Castle, Rathfarnham, and* 34, *Merrion-square, S.*
Feb. 11, 1850.	Booth, Sir Robert Gore, Bart., M. P. *Lissadill, Co. Sligo.*
Apr. 10, 1854.	Brady, Cheyne, Esq. 46, *Waterloo-road.*
Apr. 9, 1849.	Brady, D. F., M. D., F. R. C. S. I. 14, *Frederick-street, North.*
Feb. 14, 1853.	Brereton, David, A. M., Fellow K. & Q. C. P., M. D. 12, *York-street.*
Jan. 13, 1851.	Browne, Robert Clayton, Esq. *Brown's-hill, Carlow.*
Apr. 10, 1854.	Burke, Sir Bernard, Knt., Ulster King-of-Arms. *Record Tower, Castle, and* 2, *Pembroke-place.*
Jan. 10, 1842.	Burrowes, John, Esq. 1, *Herbert-street.*
Feb. 10, 1840.	Burton, Frederick W., Esq., R.H.A. *Nuremberg.*
Jan. 8, 1855.	Butcher, Richard G.H., F.R.C.S. 21, *Herbert-place.*
Apr. 11, 1842.	Butler, Very Rev. Richard, Dean of Clonmacnoise. *Trim.*

Elected.

Feb. 10, 1838. *Callwell, Robert, Esq. 25, *Herbert-place.*

Mar. 16, 1831. *Campbell, W. W., M. D. *Portstewart, Coleraine.*

Feb. 12, 1855. *Carmichael, Rev. Robert, M. A., F. T. C. D. *College.*

July 30, 1821. *Carne, Joseph, Esq., F. R. S., F. G. S. *Penzance.*

Feb. 12, 1838. *Carson, Rev. Jos., D. D., F. T. C. D. 18, *Fitzwilliam-place.*

Oct. 27, 1798. *Caulfield, Hon. Henry. *Hockley, Armagh.*

Oct. 25, 1819. *Chamley, George, Esq. 6, *Belvidere-place.*

Dec. 28, 1793. *Charlemont, Francis W., Earl of. *Charlemont House.*

Nov. 30, 1835. *Clarke, Thomas, Esq. 124, *Baggot-street, Lower.*

Jan. 11, 1841. *Clermont, Thomas, Baron. *Ravensdale Park, Flurry Bridge.*

June 23, 1845. *Connolly, Daniel, LL. D. 36, *Fitzwilliam-place.*

May 13, 1839. *Conroy, Sir Edward, Bart. *Aborfield, near Reading, Berks.*

Feb. 27, 1832. *Cooper, Edward J., Esq., F. R. S. *Markree Castle, Collooney.*

Nov. 30, 1825. *Corballis, John R., LL. D., Q. C. 19, *Lower Baggot-street, and Roebuck.*

Oct. 28, 1822. *Cork, Cloyne, and Ross, Rt. Rev. James Wilson, D. D., Lord Bishop of. *Cork.*

Nov. 30, 1835. *Courtney, Henry, Esq., A. M. 24, *Fitzwilliam-place.*

June 23, 1828. *Crampton, Hon. Justice, LL. D. 3, *Kildare-place.*

Oct. 27, 1834. *Croker, Charles P., M. D., Fellow K. & Q. C. P. 7, *Merrion-square, West.*

Nov. 30, 1833. *Cubitt, William, Esq., F. R. S., F. R. A. S. 8, *Great George's-street, Westminster, London.*

Mar. 16, 1829. *Cusack, James W., M. D. T. C. D., Professor of Surgery, T. C. D. 3, *Kildare-street.*

June 13, 1842. Cane, Arthur B., Esq. *Collingstown House, Clondalkin.*

Feb. 22, 1836. Cane, Edward, Esq. 60, *Dawson-street.*

May 13, 1850. Carlile, Hugh, M. D. T. C. D., Professor of Anatomy, Q. C., Belfast. *Prospect-terrace, Belfast.*

Feb. 12, 1855. Carte, Alex., M. D., Director of the Museum, R. D. S. 54, *Waterloo-road.*

Elected.	
Dec. 11, 1837.	Carter, Samson, Esq., C. E. *St. John's-quay, Kilkenny.*
Jan. 8, 1843.	Cather, Thomas, Esq. *Newtownlimavady.*
June 13, 1842.	Chapman, Sir Benj. I., Bart. *Killua Castle, Clonmellan.*
Jan. 10, 1842.	Churchill, Fleetwood, M. D. T.C.D., F. K. & Q. C. P. 137, *Stephen's-green, West.*
Feb. 12, 1844.	Clare, Henry, Esq. 14, *Warrington-place.*
Feb. 14, 1848.	Clarendon, Frederick Villiers, Esq., A. B., C. E. 11, *Blessington-street.*
June 9, 1845.	Claridge, James, Esq. 23, *Waltham Terrace, Blackrock.*
Jan. 9, 1837.	Clarke, Edward S., M. D. *Marlborough-street.*
May 12, 1851.	Codd, Francis, Esq. *Strickland House, Blackrock.*
Jan. 9, 1854.	Colclough, J. T. Rosborough, Esq. *Myers' Villa, Blackrock.*
June 9, 1845.	Cooke, Adolphus, Esq. *Cooksborough, Mullingar.*
Jan. 11, 1847.	Corrigan, Dominick J., M. D. T. C. D. 4, *Merrion-square, West.*
Jan. 12, 1846.	Cotton, Ven. Henry, LL. D., D. C. L., Archdeacon of Cashel. *Thurles.*
Jan. 13, 1840.	Crampton, Sir Philip, Bart., F. R. S., President, Royal College of Surgeons. 14, *Merrion-square, North.*
June 13, 1853.	Curry, Eugene, Esq., Professor of Irish Archæology and Literature, R. C. U. D. 2, *Portland-street, North.*
Apr. 11, 1853.	*Davies, Francis Robert, Esq. 10, *Mountpelier Parade, Kingstown.*
Mar. 16, 1830.	*Davis, Charles, M. D., M. R. C. S. I. 33, *York-st.*
Oct. 22, 1827.	*Davy, Edmund, Esq., F. R. S., Professor of Chemistry, Royal Dublin Society. *Kimmage.*
June 9, 1851.	*De la Ponce, Amadie. *Paris.*
Jan. 12, 1852.	*Dickinson, Joseph, A. M., M. D., F. R. S., F. L. S., President of the Lit. and Phil. Soc., and of the Royal Institution of Liverpool; President of the Lancashire and Cheshire Medical and Surgical Association. *Great George-square, Liverpool.*

Elected.

Jan. 11, 1847. *Dobbin, Leonard, Esq. 27, *Gardiner's-place.*
Jan. 13, 1851. *Dobbin, Rev. Orlando T., LL. D. *Navan.*
Apr. 27, 1835. *D'Olier, Isaac M., Esq. *Colignes, Booterstown.*
Nov. 29, 1817. *Drummond, Rev. William Hamilton, D. D.—LIBRARIAN. 27, *Gardiner-street, Lower.*
Jan. 9, 1843. *Drury, William Vallancey, M. D. 5, *The Crescent, Camden-road, Regent's Park, London.*
Jan. 27, 1834. *Dublin, Most Rev. Richard Whately, D. D., Archbishop of, V. P. Royal Zoological Society of Ireland. *Palace, Stephen's-green.*
Oct. 25, 1830. *Dunraven, Right Hon. Edwin Richard, Earl of, F. R. S., F. A. S. *Adare Manor, Adare.*
Apr. 13, 1846. D'Arcy, Matthew P., Esq. 49, *Mount-st., Upper.*
Feb. 14, 1853. Dargan, William, Esq. *Mount-Annville House, Dundrum.*
May 11, 1840. Davidson, John, Esq., M. E. C. *Armagh.*
May 14, 1855. Davy, Edmund William, A. B., M. B. T. C. D. *Kimmage.*
Jan. 12, 1846. Deasy, Rickard, Esq., M.P. 184, *Brunswick-st., Gt.*
Feb. 11, 1839. Dixon, Rev. Robert Vickers, A. M. *Clogherny Rectory, Dungannon.*
May 12, 1845. Dobbs, William Carey, Esq. 21, *Fitzwilliam-place.*
Feb. 13, 1854. Domville, Charles C. W., Esq. 41, *Gardiner-street, Lower.*
Jan. 11, 1847. Donovan, Michael, Esq. 11, *Clare-street.*
May 26, 1834. Doyne, Charles, Esq. *Newtownpark, Blackrock.*
June 11, 1838. Drennan, William, Esq. 35, *Cumberland-st., North.*
Jan. 8, 1849. Dungannon, Viscount. *Brynkinalt, Denbighshire.*
Jan. 10, 1842. Dunlop, Durham, Esq. 76, *Mount-street, Lower.*
Apr. 12, 1847. *Esmonde, Right Hon. Sir Thomas, Bart. 9, *Denmark-street, Great.*
June 14, 1847. Egan, John C., M. D. *London.*
Dec. 11, 1843. Eiffe, James S., Esq. *Plantation House, Amersham, Bucks.*
Jan. 12, 1846. Enniskillen, William Willoughby, Earl of, F.R.S., F. G. S. L., &c. *Florence Court.*
Feb. 13, 1854. *Ferguson, Rev. Robert, LL.D., F. S. A. L. *Ryde.*
Apr. 28, 1828. *Foot, Simon, Esq. 4, *Avoca-terrace, Blackrock.*

Elected.	
Nov. 11, 1844.	Farnham, Henry, Lord, D. L., K. St. P. *Farnham, Co. Cavan.*
Mar. 15, 1834.	Ferguson, Samuel, Esq. 20, *George's-st., North.*
Jan. 10, 1842.	Ferrier, Alexander, Esq., A. M. *Knockmaroon.*
Dec. 11, 1837.	Finlay, John, LL. D. 31, *Cumberland-st. North.*
Nov. 12, 1850.	Fitzgerald, Lord William. 20, *Fitzwilliam-place.*
Apr. 11, 1853.	Fitzgerald, Ven. William, D. D., Archdeacon of Kildare, Professor of Ecclesiastical History, T. C. D. *The Glebe, Monkstown, and the Palace, Stephen's-green.*
Apr. 12, 1841.	Fitzgibbon, Gerald, Esq. 10, *Merrion-sq., North.*
June 9, 1851.	Fleming, Christopher, M. D. T. C. D. 31, *Molesworth-street.*
June 14, 1852.	Foot, Lundy Edward, Esq., Hon. Sec., R. D. S. 14, *Fitzwilliam-street, Upper.*
Apr. 8, 1850.	Fowler, Robert, Esq., D. L. 23, *Rutland-square, North.*
Jan. 14, 1850.	Fox, Sir Charles, C. E. 8, *New-street, Spring Gardens, London.*
Nov. 12, 1838.	Frazer, G. A., Esq., Captain R. N. 2, *Durham-place, Kingstown.*
May 10, 1847.	Freke, Henry, M. D. T. C. D., F. G. S., &c. 28, *Holles-street.*
Apr. 9, 1855.	*Gilbert, John T., Esq. *Villa Nova, Blackrock.*
May 25, 1836.	*Gough, Hon. George Stephens, A. M., F. L. S., F. G. S. L., D. L. *Rathronan House, Clonmel.*
June 12, 1848.	*Graham, Andrew, Esq. *Markree Observatory.*
Apr. 10, 1848.	*Graham, Rev. William.
Apr. 24, 1837	*Graves, Rev. Charles, D. D., Fellow and Professor of Mathematics, and Erasmus Smith's Professor of Mathematics, T. C. D.—VICE-PRESIDENT. *College.*
Mar. 16, 1824.	*Grierson, George A., Esq. 93, *Leeson-st., Lower.*
Apr. 26, 1819.	*Griffith, Richard, LL. D., F. R. S. E., F. G. S., V. P. Geological Society, President of the Institution of Civil Engineers of Ireland. 2, *Fitzwilliam-place.*
Apr. 9, 1849.	*Guinness, Benjamin Lee, Esq. *St. Anne's, Clontarf.*

Elected.

Apr. 14, 1845. Galbraith, Rev. Joseph, A. M., F. T. C. D., Erasmus Smith's Professor of Natural and Experimental Philosophy, T. C. D. *College.*

Jan. 13, 1845. Getty, Edmund, Esq. *Belfast.*

Jan. 13, 1851. Gibson, James, Esq. 18, *Mountjoy-square, South.*

Jan. 13, 1851. Gordon, Samuel, M. B., F.R.C.S.L. 11, *Hume-st.*

Jan. 9, 1837. Gregory, William, M. D., F. R. S. E. *Edinburgh.*

Dec. 11, 1837. Gregory, Very Rev. James, A M., Dean of Kildare. 17, *Fitzwilliam-street, Upper.*

Jan. 13, 1851. Griffin, Daniel, M.D., M.R.C.S.L. *Limerick.*

Jan. 10, 1842. Grimshaw, Wrigley, Esq. 13, *Molesworth-street.*

Jan. 14, 1839. Grubb, Thos., Esq. 14, *Leinster-terrace, Rathmines.*

Jan. 10, 1848. *Haliday, Alexander Henry, Esq., A.M. 23, *Harcourt-street.*

Jan. 11, 1847. *Haliday, Charles, Esq. *Monkstown Park.*

Oct. 22, 1827. *Hamilton, Sir William Rowan, Knt., LL. D., F. R. A. S., Astronomer Royal of Ireland, and Andrews' Professor of Astronomy, T. C. D.—Ex-President. *Observatory, Dunsink.*

Apr. 13, 1840. *Hanna, Samuel, A. M., M. B., F. K. & Q. C. P. 42, *Leinster-road, Rathmines.*

Apr. 24, 1820. *Hardiman, James, Esq. *Galway.*

Nov. 30, 1829. *Hardy, Philip Dixon, Esq. *Greenfield Lodge, Donnybrook.*

Jan. 25, 1830. *Harrison, Robert, M.D. T.C.D., Professor of Anatomy, T. C. D.; Hon. Sec., R. D. S. 1, *Hume-street.*

Feb. 13, 1837. *Hart, Andrew Searle, LL. D., F. T. C. D. *Killester, Raheny.*

Apr. 28, 1828. *Hart, John, M. D. 77, *Charlemont-street.*

May 13, 1844. *Harvey, William H., M. D. T. C. D., Keeper of Botanical Museum, T C. D. 40, *College.*

Apr. 12, 1852. *Head, Henry H., M.D., F.C.S. 28, *Mount-st., Up.*

June 8, 1840. *Hemans, George Willoughby, Esq., C. E. 10, *Rutland-square, East.*

Jan. 13, 1851. *Hennessy, Henry, Esq., Professor of Natural Philosophy, R. C. U. D. *Stephen's-green, South.*

Mar. 16, 1831. *Hill, Lord George A. *Guydore, Dunfanaghy.*

Elected.

Nov. 28, 1803. *Hincks, Rev. Thomas Dix, LL.D., First Sec. Royal Cork Institution. *Belfast.*

Nov. 30, 1847. *Hodgkinson, Eaton, Esq., F. R. S., F. G. S., &c., Professor of the Mechanical Principles of Engineering, University College, London. 44, *Drayton Grove, Brompton, London.*

Apr. 12, 1847. *Hone, Nathaniel, Esq. *St. Doulough's, County Dublin.*

June 9, 1851. *Hone, Thomas, Esq. *Yapton, Monkstown.*

Feb. 28, 1825. *Hudson, Henry, M. D., F. K. & Q. C. P. 23, *Stephen's-green, North.*

June 24, 1816. *Hutton, Robert, Esq., F. G. S. *Putney-park, Surrey.*

Feb. 10, 1840. *Hutton, Thomas, Esq., D. L., F. G. S. *Elm-park, and* 118, *Summer-hill.*

Jan. 9, 1843. *Hutton, Henry, Esq. 18, *Gardiner's-place.*

Apr. 25, 1836. Hamilton, Charles William, Esq., F. G. S. 40, *Dominick-street, Lower.*

Jan. 13, 1845. Hamilton, George Alexander, LL. D., M. P., Vice-President R. D. S. *Hampton Hall, Balbriggan.*

Jan. 11, 1847. Hancock, William Neilson, LL. D. 74, *Gardiner-street, Lower.*

June 10, 1844. Hanlon, Charles H., Esq. *Bedford House, Rathgar.*

Apr. 8, 1850. Hardinge, William Henry, Esq. 16, *Buckingham-street, Upper.*

Feb. 24, 1845. Haughton, Rev. Samuel, A. M., F. T. C. D., Professor of Geology, T.C.D. 17, *Heytesbury-terrace.*

May 13, 1845. Henn, William, Esq., Master in Chancery. 17, *Merrion-square, South.*

June 23, 1851. Higgins, Joseph Napier, Esq. *Old Square, Lincoln's Inn, London.*

June 10, 1842. Hogan, William, Esq., A. M. 9, *Haddington-terrace, Kingstown.*

Apr. 27, 1835. Hutton, Edward, M. D. T. C. D. 29, *Gardiner's-place.*

Jan. 11, 1847. Ingram, John Kells, LL. D., F. T. C. D., Erasmus Smith's Professor of Oratory, T.C.D. 40, *College.*

Apr. 12, 1852. Irwin, William Nelson, Esq. *Crimea.*

Elected.

Nov. 30, 1835. *Jessop, Frederick Thomas, Esq. *Doory Hall, Longford.*

Jan. 14, 1839. *Jones, Major-General Harry D., R. E. *Crimea.*

Jan. 12, 1852. *Jukes, Joseph Beete, Esq., A. M., F. R. S., Vice-President of Geological Society of Dublin, Local Director of the Geological Survey of Ireland, and Lecturer on Geology in the Museum of Irish Industry. 72, *Leeson-street, Upper.*

Jan. 13, 1845. James, Henry, Lieut.-Col. R. E., F. R. S. *Portsmouth.*

Jan. 9, 1837. James, Sir John Kingston, Bart. 9, *Cavendish-row.*

Nov. 8, 1841. Jellett, Rev. John H., A. M., F. T. C. D., Professor of Natural Philosophy, T.C.D.—SECRETARY OF THE COUNCIL. 18, *Heytesbury-terrace.*

June 13, 1842. Jennings, Francis M., Esq. *Brown-street, Cork.*

Apr. 12, 1847. Jones, Philip, Esq. *Nutgrove, Rathfarnham.*

Jan. 25, 1836. Joy, Henry Holmes, Esq., A. M. 17, *Mountjoy-square, East.*

Nov. 30, 1831. *Kane, Sir Robert, M. D., F. R. S., President of Q. C., Cork; F. K. & Q. C. P., and Director of the Economic Museum, Dublin.—VICE-PRESIDENT.

June 24, 1833. *Kelly, Denis Henry, Esq. *Castle Kelly, Mount Talbot, Roscommon.*

Apr. 13, 1846. *Kennedy, James Birch, Esq. 50, *Dame-street.*

Apr. 8, 1844. *Kildare, Marquis of, Vice-President R. D. S. *Kilkea Castle, Maganey.*

Dec. 10, 1849. *King, Rev. Henry, LL. D. *Ballylin, Firbane.*

Feb. 13, 1837. *Knox, Rev. Thomas. *Lurgan.*

Feb. 13, 1837. *Knox, George J., Esq. 2, *Finchley, New Road, London.*

Jan. 11, 1841. *Knox, Very Rev. H. Barry. *Deanery House, Hadleigh.*

Nov. 30, 1835. *Kyle, William Cotter, LL. D. 8, *Clare-street.*

Jan. 25, 1836. Kelly, Thomas F., LL. D. *Howth.*

Apr. 14, 1851. Kelly, William, M. D. 18, *Leinster-road, Rathmines.*

Nov. 30, 1835. Kennedy, George A., M. D. T. C. D. 15, *Talbot-street.*

Elected.

Apr. 9, 1849. Kennedy, Henry, M. B., F. K. & Q. C. P. 17, *Frederick-street, North.*

Apr. 10, 1848. Kenny, James Christopher Fitzgerald, Esq., J. P. *Kilclogher, Co. Galway, and* 2, *Merrion-sq., S.*

May 14, 1838. Kent, William T., Esq. 51, *Rutland-square, West.*

June 9, 1851. Kilmore, Elphin, and Ardagh, Right Rev. Marcus Gervais Beresford, D. D., Lord Bishop of. *Kilmore House, Cavan.*

June 8, 1845. King, Charles Croker, M. D., Professor of Anatomy and Physiology, Q. C., Galway. *Galway.*

Nov. 30, 1833. *Larcom, Thomas A., Lieut. Col. R. E., LL. D., F. R. S., Under Secretary for Ireland.—Vice-President. *Dublin Castle.*

Mar. 16, 1820. *Lardner, Rev. Dionysius, LL. D., F. R. S. L. E., F. R. A. S., &c. *Paris.*

Feb. 23, 1835. *La Touche, David Charles, Esq. *Marlay, Rathfarnham.*

Jan. 25, 1836. *La Touche, Wm. Digges, Esq. 34, *Stephen's-green, North.*

May 13, 1839. *Leader, Nicholas P., Esq. *Dromagh Castle, Castlemills, Cork.*

Apr. 10, 1843. *Leinster, His Grace the Duke of, President of the Irish Archæological and Celtic Society. *Carton, Maynooth, and* 13, *Dominick-street, Lower.*

Apr. 28, 1828. *Lenigan, James, Esq. *Castle Fogarty, Thurles.*

Feb. 27, 1832. *Lloyd, Rev. H., D. D., F. R. S., Hon. F. R. S. E., S. F. T. C. D. *Trinity College, and Kilcroney, Bray.*

Jan. 12, 1846. *Lloyd, William, M. D. *London.*

Feb. 25, 1833. *Luby, Rev. Thomas, D.D., S.F.T.C.D., Regius Professor of Greek, T. C. D. 43, *Leeson-street.*

Jan. 13, 1845. *Lucas, Right Hon. Edward. *Castle Shane, Co. Monaghan.*

Apr. 11, 1842. Law, Robert, M. D., King's Professor of the Institutes of Medicine, T. C. D. 54, *Rutland-square, West.*

May 10, 1852. Leared, Arthur, M. B. *New Civil Hospital, Smyrna.*

Elected.

Feb. 14, 1853. Leeper, Rev. Alexander, A. M. 10, *Kildare-street.*

Jan. 13, 1845. L'Estrange, Francis, Esq., A. M., F. R. C. S. I. 39, *Dawson-street.*

Feb. 10, 1845. Le Fanu, William, Esq., C. E. 7, *Fitzwilliam-square, North.*

May 11, 1846. Lefroy, George, Esq. 18, *Leeson-street.*

Apr. 11, 1853. Lentaigne, John, M. D., D. L. 1, *Denmark-street, Great, and Tallaght House.*

Jan. 13, 1840. Lloyd, William T., Esq. 10, *Crescent, Mount-street, Upper.*

Feb. 10, 1845. Longfield, Rev. George, A. M., F. T. C. D. *College.*

Feb. 12, 1838. Longfield, Mountiford, LL. D., Regius Professor of Feudal and English Law, T. C. D. 6, *Fitzwilliam-square, West.*

June 24, 1839. Longfield, William, Esq. 19, *Harcourt-street.*

Jan. 8, 1849. Luscombe, William Hill, Esq., C. E. *Adelaide-terrace, Upper Leeson-street.*

Mar. 16, 1836, Lyle, Acheson, Esq., A. M., Chief Remembrancer. 19, *Merrion-square, South.*

May 12, 1851. Lyons, Robert D., M. B. *Crimea.*

Jan. 9, 1812. *Mac Carthy, Viscount de. *Toulouse.*

Mar. 16, 1827. *Mac Donnell, John, M. D. 4, *Gardiner's-row.*

Oct. 23, 1820. *Mac Donnell, Rev. Richard, D.D., Provost, T.C.D. *Provost's House, and Dalkey.*

June 25, 1821. *Mackay, James Townsend, LL. D., Director of Trin. College Botanic Garden. *Ball's-bridge.*

Feb. 10, 1840. *M'Kay, Rev. Maurice, LL. D. *Magheragall, Lisburn.*

May 8, 1837. *M'Neece, Rev. Thomas, D. D., Archbishop King's Lecturer in Divinity, T. C. D. *College.*

Feb. 28, 1831. *Mac Neill, Sir John, LL. D., F. R. S., F. R. S. A., Extraordinary Professor of Civil Engineering, T. C. D. *Newry.*

Jan. 23, 1826. *Magrath, Sir George, K. H., M. D., F. R. S., F. L. S., F. G. S. *Plymouth.*

Oct. 22, 1832. *Mallet, Robert, Esq., C. E., F. R. S., V. P. Geological Society of Dublin. *Delville, Glasnevin, and 9, Ryder's-row.*

Elected.

June 22, 1826. *Marsh, Sir H., Bart., M. D. T. C. D., F. K. & Q. C. P. 9, *Merrion-square, North.*

Mar. 15, 1828. *Martin, Very Rev. John C., D. D., Dean of Ardagh *Killeshandra.*

June 22, 1812. *Mason, Henry Joseph Monck, LL. D. *Bray.*

Mar. 15, 1817. *Mayne, Rev. Charles. *Kilalloe.*

Mar. 16, 1813. *Meath, Lord Bishop of, Right Hon. and Most Rev. Joseph Henderson Singer, D. D. *Ardbraccan House, Navan,* and 40, *Fitzwilliam-place.*

Apr. 28, 1828. *Montgomery, William F., M. D., Professor of Midwifery to the College of Physicians. 8, *Merrion-square, North.*

Apr. 11, 1853. Mac Carthy, James Joseph, Esq. 7, *Leinster-road, Rathmines.*

Feb. 14, 1853. M'Clintock, Alfred H., M.D., Master of the Lying-in Hospital. *Rutland-square.*

Feb. 24, 1845. Macdonnell, James S., Esq., C. E. *Summer-hill.*

Dec 11, 1843. Mac Dougall, William, Esq. *Drumleek House, Howth.*

June 8, 1846. M'Ghee, R. J. *Holywell, St. Ives, Hants.*

Feb. 23, 1846. Madden, Richard Robert, Esq. *Leitrim Lodge, Castlewood-avenue, Rathmines.*

Feb. 13, 1843. Magee, James, Esq. 39, *Leeson-street, Lower.*

Jan. 13, 1851. Maley, Andrew John, Esq. 7, *Merrion-square, S.*

Oct. 24, 1836. Marks, Rev. Edward, D. D. 2, *Heytesbury street.*

Jan. 14, 1850. Melville, Alexander Gordon, M. D., M. R. C. S. Eng., and F. B. S., Professor of Natural History, Q. C., Galway. *Galway.*

Jan. 10, 1848. Miller, George Mackay, Esq., C. E. *Susan Vale, Inchicore-road.*

Jan. 13, 1840. Mollan, John, M. D. T. C. D., F. K. & Q. C. P. 8, *Fitzwilliam-square, North.*

Apr. 12, 1841. Monsell, William, Esq., M. P. *Tervoe, Limerick.*

Jan. 14, 1850. Moore, Christopher, Esq. 22, *Howland-street, Fitzroy-square, London..*

June 23, 1845. Moore, David, Esq. *Glasnevin.*

Feb. 12, 1855. Moore, Rev. Ogle William. *Blessington, Co. Wicklow.*

Elected.

Apr. 12, 1841. Mulvany, William Thomas, Esq. *Dusseldorf, Prussia.*

Apr. 12, 1852. Muspratt, Sheridan, Esq., Ph. D., F.R.S. *Royal College of Chemistry, Liverpool.*

Feb. 10, 1840. *Napier, Right Hon. Joseph, LL. D., M. P. 17, *Mountjoy-square, South.*

Jan. 8, 1844. *Neville, John, Esq., C.E. *Jocelyn-street, Dundalk.*

Nov. 30, 1835. *Nicholson, John A., A. M. *Balrath House, Kells.*

Feb. 10, 1845. Neligan, J. Moore, M.D.T.C.D., F.K. & Q.C.P. 17, *Merrion-square, East.*

May 8, 1854. Neville, Parke, Esq., C. E. 79, *Leeson-st., Lower.*

Jan. 12, 1846. Nugent, Arthur R., Esq. *Portaferry House, Portaferry.*

May, 27, 1833. *Odell, Edward S., Esq. *Carriglea House, Dungarvan.*

Nov. 30, 1832. *O'Ferrall, Joseph M., M. D. 15, *Merrion-sq., N.*

Feb. 12, 1849. *Ogilby, William L., Esq. *Liscleen House, Dunamanagh.*

Feb. 25, 1833. *O'Reilly, Miles John, Esq. *Paris.*

Dec. 10, 1838. *Orpen, John Herbert, LL. D. 13, *Frederick-street, South.*

Apr. 8, 1839. *Owen, John Underhill, M. D. *London.*

Feb. 8, 1847. O'Donovan, John, LL.D., Professor of Celtic Languages, Q. C., Belfast. 36, *Buckingham-st., Up.*

Feb. 10, 1845. O'Driscoll, W. Justin, Esq. 30, *Gardiner's-place.*

Feb. 13, 1854. O'Flanagan, James R., Esq. *Elm Cliff House, Blackrock.*

Feb. 10, 1845. O'Gorman, N. Purcell, Esq. 45, *Blessington-street.*

May 23, 1836. O'Grady, Michael Martin, M. D. *Malahide.*

June 10, 1844. Oldham, Thomas, A. M., F. R. S., F. G. S. *India.*

June 10, 1839. Osborne, Jonathan, M. D. T. C. D., King's Professor of Materia Medica, T. C. D. 26, *Harcourt-st.*

Apr. 9, 1838. Owen, Jacob, Esq. 2, *Mountjoy-square, West.*

Jan. 8, 1855. Owen, James Higgins, Esq. 29, *Gloucester-st., Lr.*

June 10, 1839. *Parker, Alexander, Esq. 46, *Rathmines.*

Feb. 25, 1828. *Petrie, George, LL. D., R. H. A.—VICE-PRESIDENT. 67, *Rathmines.*

Apr. 12, 1841. *Phibbs, William, Esq. *Seafield, Sligo.*

Elected.	
Dec. 11, 1843.	*Pickford, James H., M. D. *Brighton.*
Feb. 12, 1838.	*Pim, Geo., Esq. *Brennan's-town, Cabinteely.*
Nov. 30, 1833.	*Pim, James, Esq. 15, *Mount-street, Upper.*
Jan. 8, 1849.	*Pim, Jonathan, Esq. *Greenbank, Monkstown.*
Jan. 13, 1851.	*Pim, William Harvey, Esq. *Monkstown House.*
Apr. 25, 1836.	*Porter, Rev. Thomas H., D. D. *Tullahogue, Dungannon.*
May 24, 1830.	*Portlock, Joseph Ellison, Lieut.-Col. R.E., F.R.S., F. G. S. *Woolwich.*
Oct. 25, 1830.	*Prior, James, Esq. 20, *Norfolk-crescent, Hyde-Park, London.*
Jan. 8, 1849.	*Purser, John, Esq. *The Castle, Rathmines.*
Apr. 10, 1843.	Pakenham, Hon. and Very Rev. Henry, Dean of St. Patrick's. 40, *Harcourt-street.*
June 14, 1841.	Patten, James, A. M., M. D. *Belfast.*
Feb. 10, 1845.	Pigot, Right Honourable David R., Chief Baron. 52, *Stephen's-green, East.*
June 9, 1851.	Pigot, John Edward, Esq. 96, *Leeson-street, Lower.*
June 23, 1845.	Porter, Rev. Classon. *Larne.*
Apr. 12, 1852.	Porter, Henry John, Esq. *New Zealand*
Jan. 9, 1854.	Pratt, James Butler, Esq. *Blackrock.*
Feb. 10, 1845.	Preston, Algernon, Esq. 14, *Gloucester-street.*
Dec. 14, 1846.	*Reeves, Rev. William, D. D. *Ballymena.*
Feb. 24, 1834.	*Reid, Robert, M. D. T. C. D., F. K. & Q. C. P. *Corrig-avenue, Kingstown.*
Feb. 13, 1843.	*Renny, Henry L., Esq. *London.*
Apr. 8, 1839.	*Rhodes, Thomas, Esq., C. E. *Alderney.*
Feb. 14, 1816.	*Robinson, Rev. Thomas Romney, D. D.—PRESIDENT. *Observatory, Armagh.*
June 10, 1844.	*Roe, Henry, Esq., A. M. 2, *Fitzwilliam-square, E.*
June 27, 1825.	*Rossmore, Henry Robert, Lord. *Rossmore Park, and The Dell, Windsor.*
Oct. 22, 1832.	*Rosse, Right Hon. William, Earl of, F. R. S., F. R. A. S., &c. *Birr Castle, Parsonstown.*
May 28, 1832.	*Rowan, Rev. Arthur B., D. D. *Belmount, Tralee.*
Apr. 11, 1853.	Read, Alexander, M. D. 13, *Hume-street.*
Jan. 8, 1849.	Rickards, John L., Esq., C. E. 2, *Gloucester-terrace, Regent Park, London.*

Elected.

Apr. 9, 1855. Ringland, John, M. B. T.C. D. 14, *Harcourt-st.*
Jan. 12, 1852. Roe, George, Esq. *Nutley, Donnybrook.*
Apr. 27, 1835. *Sadleir, Rev. William Digby, D. D., S. F. T. C. D. 43, *Fitzwilliam-place.*
Jan. 9, 1843. *Salmon, Rev. George, A. M., F. T. C. D. 2, *Heytesbury-terrace, Wellington-road.*
Jan. 8, 1855. *Senior, Edward, Esq. *Ashton, Phœnix Park.*
Feb. 9, 1846. *Sherrard, James Corry, Esq. *Kinnersley Manor, Reigate, Surrey.*
July 27, 1829. *Sirr, Rev. Joseph D'Arcy, D. D. 8, *Warwick-terrace, Belgrave-road, London.*
June 23, 1834. *Smith, Rev. George Sydney, D. D., Professor of Biblical Greek, T. C. D. 9, *College.*
Apr. 22, 1833. *Smith, J. Huband, Esq., A. M. 1, *Holles-street.*
May 30, 1785. *Stewart, Hon. Alexander.
June 25, 1819. *Strong, Ven. Charles, A. M., Archdeacon of Glendalough. 6, *Cavendish-row.*
Feb. 24, 1845. *Sweetman, Walter, Esq. 4, *Mountjoy-square, North.*
Jan. 10, 1853. Sanders, Gilbert, Esq. 10, *Heytesbury-terrace.*
Feb. 24, 1845. Sausse, M. R., Esq. 5, *Hume-street.*
May 12, 1851. Sayers, Rev. Johnston Bridges, LL. D. *Madras.*
May 12, 1851. Scully, Vincent, Esq., M. P. 13, *Merrion-square, South.*
Feb. 14, 1848. Segrave, O'Neal, Esq., D. L. *Kiltimon, Newtownmountkennedy.*
Jan. 11, 1847. Sidney, Frederick John, LL. D., Sec. Geol. Soc. of Dublin. 19, *Herbert-street.*
Feb. 23, 1835. Smith, Aquilla, M. D. T. C. D., F. K. & Q. C. P., Treasurer Irish Archæological and Celtic Society. 121, *Lower Baggot-street.*
June 9, 1851. Smith, Catterson, Esq., R. H. A. 42, *Stephen's-green, East.*
Apr. 10, 1837. Smith, Robert William, M. D., Professor of Surgery, T. C. D. 63, *Eccles-street.*
Jan. 8, 1849. Smyth, Henry, Esq., C. E. *Downpatrick.*
June 13, 1842. Staples, Sir Thomas, Bart., D. L. *Sissane, Co. Tyrone, and* 11, *Merrion-square, East.*
Apr. 13, 1846. Stapleton, Michael H., M. B. 1, *Mountjoy-place.*

Elected.	
May 12, 1845.	Starkey, Digby Pilot, Esq., A. M. *Bayswater Dalkey.*
Apr. 11, 1853.	Stewart, Henry H., M. D. 71, *Eccles-street.*
Nov. 29, 1834.	Stokes, William, M. D., Regius Professor of Physic in the University of Dublin. 5, *Merrion square, North.*
Feb. 14, 1848.	*Tarrant, Charles, Esq., C. E.
Jan. 12, 1846.	*Tenison, Edward King, Esq. *Kilronan, Keadue Carrick-on-Shannon.*
Feb. 8, 1847.	*Tibbs, Rev. Henry, A. M. *Nottingham.*
Oct. 28, 1833.	*Todd, Rev. James Henthorn, D. D., S. F. T. C. D. Erasmus Smith's Professor of Hebrew, T. C. D.—SECRETARY. 35, *College.*
Feb. 14, 1816.	*Turner, William, Esq.
June 23, 1845.	Talbot de Malahide, Lord, President, Royal Zoological Society; Vice-President, R. D. S. *Malahide Castle.*
Feb. 14, 1848.	Talbot, Matthew E., Esq. *Ferry Bank, Wexford*
Feb. 14, 1848.	Taylor, Very Rev. J. J., D. D. *Rathvilly, Co. Wicklow.*
Apr. 12, 1841.	Tighe, Robert, Esq. 14, *Fitzwilliam-square, North*
Feb. 24, 1845.	Townsend, R. William, Esq., C. E.
Feb. 9, 1846.	Tufnell, Thomas Jolliffe, F. R. C. S. I. 58, *Lower Mount-street.*
May 26, 1834.	*Vandeleur, Crofton Moore, Colonel. *Kilrush.*
Apr. 9, 1849.	Vesey, Hon. Thomas, M. P. *Abbeyleix.*
Jan. 25, 1836.	Vignoles, Charles, Esq., F. R. S. *Trafalgar-square London.*
Apr. 10, 1837.	*Wall, Rev. Charles William, D. D., Vice-Provost T. C. D. 20, *College.*
Apr. 28, 1823.	*Wall, Rev. Richard H., D. D. 6, *Hume-street.*
Feb. 25, 1822.	*Walshe, Francis Weldon, Esq. *Limerick.*
Jan. 29, 1816.	*Weaver, Thomas, Esq., F. R. S., F. G. S. 16, *Stafford-row, Pimlico, London.*
Mar. 15, 1800.	*Weld, Isaac, Esq., F. G. S., Vice-President, R. D. S. *Ravenswell, Bray.*
Jan. 13, 1851.	*Whittle, Ewing, M. D. 1, *Parliament-terrace Liverpool.*

Elected.

une 10, 1839. *Wilde, William R., Esq. 21, *Westland-row.*

an. 9, 1837. *Williams, Thomas, Esq. 71, *Stephen's-green.*

an. 14, 1839. *Williams, Richard Palmer, Esq. *Drumcondra Castle.*

lar. 16, 1824. *Wilmot-Chetwode, Edward, Esq. *Woodbrook, Portarlington.*

une 10, 1844. *Wilson, Robert, Esq. *Richmond, Monkstown.*

Apr. 12, 1841. *Wilson, Thomas, Esq. *Westbury, and* 15, *Upper Temple-street.*

Apr. 13, 1840. Wallace, Robert Alexander, Esq., A. M. 26, *Molesworth-street.*

Apr. 14, 1845. Waller, John Francis, LL. D. 4, *Herbert-street.*

Jan. 11, 1841. West, Ven. John, D. D., Archdeacon of Dublin. 6, *Wilton-square.*

Feb. 23, 1845. Williams, Robert C., M. D. T. C. D., Vice-President of the College of Surgeons. *Fitzwilliam-street, Lower.*

Jan. 14, 1839. Wills, Rev. James, B. D. *Kilmacow, Waterford.*

Apr. 13, 1846. Wingfield, Hon. and Rev. William. *Abbeyleix.*

Apr. 10, 1843. Wynne, John, Right Hon. *Hazlewood, Co. Sligo.*

Feb. 24, 1845. Yeates, George, Esq. 2, *Grafton-street.*

NOTE.—The names of parties whose subscriptions are in arrear, two years and upwards, are not printed in this list, which is corrected to the 7th July, 1855.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

NOVEMBER 14TH, 1853.

HUMPHREY LLOYD, D. D., VICE-PRESIDENT, in the Chair.

THE Secretary announced the bequest of books and manuscripts made to the Academy by the late William Elliott Hudson, Esq., M. R. I. A.; and also the donation of his Bust by MOORE, presented by his Executors.

RESOLVED,—That the thanks of the Academy be presented to the Executors of the late William E. Hudson, Esq., for their donation of his Bust, and that the Academy entertain the highest sense of the value of the bequest left by Mr. Hudson to the Academy.

RESOLVED,—That the bust of the late W. E. Hudson, Esq., be placed in the Library, as a mark of respect to his memory, and of gratitude for the bequest with which he has enriched the Library of the Academy.

The Rev. Charles Graves, D. D., read a paper on the solution of linear differential equations.

The object of the present paper is to contribute to our knowledge of the soluble forms of linear differential equations. The left-hand member of the equation

$$D^n y + AD^{n-1}y + By \,.\,. = X$$

in which A, B, &c., are any functions of x, being regarded as the result of the operation of

$$D^n + AD^{n-1} + \ldots B$$

upon y, all attempts to solve it by the method of the separation of symbols must be directed to the transformation of this operator into a form in which it appears as the product of a series of operations, each of which admits of being inverted; and, conversely, if the result of a series of such operations be to produce a complex operation of the preceding form, we may apply it to the construction of soluble forms of differential equations.

Thus the operation

$$(D + \phi)(D + \psi),$$

in which ϕ and ψ denote any functions of x, will be found on development to be equal to

$$D^2 + (\phi + \psi) D + (\phi\psi + \psi');$$

consequently, we may identify the general linear differential equation of the second order,

$$D^2y + ADy + By = X \qquad (1)$$

with

$$D^2y + (\phi + \psi) Dy + (\phi\psi + \psi')y = X. \qquad (2)$$

And if we could succeed in solving the equations

$$\phi + \psi = A, \ \phi\psi + \psi' = B, \qquad (3)$$

and so obtaining finite values of ϕ and ψ in terms of A and B, we should be able to effect the solution of the general linear differential equation of the second order, at least in a symbolic form; for as

$$(D + \phi)^{-1} = e^{-\int\phi dx}\int e^{\int\phi dx}$$

and

$$(D + \psi)^{-1} = e^{-\int\psi dx}\int e^{\int\psi dx},$$

we should have

$$y = e^{-\int\psi dx}\int e^{\int(\psi-\phi)dx}\int e^{\int\phi dx} X.$$

Unfortunately it happens that, in trying to determine ϕ and ψ from the equations (3), we either obtain a differential equation of the first order and *second* degree, or are led back again to the solution of the equation (1).

We may, however, make most advantageous use of the equation (2) by assigning arbitrary forms to the functions ϕ and ψ contained in it, and so construct soluble forms *ad libitum.*

When the equation (1) wants the term involving Dy, we have

$$\phi + \psi = 0 \text{ and } \phi\psi + \psi' = \mathrm{B}.$$

Hence $$-\phi^2 - \phi' = B. \tag{4}$$

Now, as the second term of the equation (1) can always be banished by a change of the dependent variable, we have arrived at the remarkable result that the solution of the general linear differential equation of the second order depends upon that of the equation (4), whose form is particular and unchanging: and this result is practically important; for if we tabulate the values of $\phi^2 + \phi'$ for all values of ϕ, we should have the solutions themselves of linear differential equations of the second order tabulated at the same time.

By interchanging the symbols x and D in the preceding formulæ, according to the method pointed out by Dr. Hargreave, we are led to a series of general and interesting results.

Dr. Todd made some remarks on the fresco painting in the Abbey of Knockmoy, in the county Galway, of which a fac-simile copy, the exact size of the original, was exhibited in the Antiquarian Court of the Dublin Exhibition.

The public are indebted for the preservation and exhibition of this ancient monument of Irish art to the zeal of Dr. John Lentaigne, at whose instance, and by whose personal exertions, the fac-simile was obtained for the Committee of the Exhibition. The following account of the manner in which the inscriptions were deciphered is given in a letter dated 13th June, 1853, addressed to Dr. Todd by Mr. Eugene Curry:

"John Lentaigne, Esq., on the part of the Committee of the Great Industrial Exhibition, having done me the honour to request me to accompany him to the ruins of the once

noble Abbey of *Cnoc m-Buaidh*, now Knockmoy, in the County of Galway, I proceeded there with him, accompanied by my son, Henry B. Curry, on Saturday evening, 11th [of June] instant. Having reached Athenree in due time, and rested for the night, we proceeded, on Sunday morning, yesterday, to the Abbey, where we arrived after a smart drive of about two hours. We found the inscription in a very hopeless state of decay, having suffered almost total extinction in several places, only three perfect words remaining on the lower line. I examined the faint traces that remained, from the first that presents itself to the last; but with little satisfaction, until I came to the words, 'eddichan qui fieri fecit,' which I read with ease, and I may indeed say with delight, as I thought I had found a key to the whole, and I knew that it had never been read, although attempted by Charles O'Conor, of Belanagare, Theophilus O'Flanagan, Ledwich, Petrie, O'Donovan, and others. Dr. Lentaigne and my son then made separate drawings of the whole, as far as they could trace it, and, having got this, we recovered the leading words, 'Ora pro animabus Malachie,' and then the name Finola, which clearly settled the chief part of the inscription and its proximate date. It was not until after my return this morning that I succeeded, by the assistance of my friend, Dr. John O'Donovan, in settling the Christian name of the artist, which is Conchubhar, and the inscription therefore reads:—

"'Ora pro animabus malachie, inollain, et chonchubhuir hi Eddichan qui fieri fecet' [*sic*].

"Our next attempt was at the top line, from which, by the aid of a ladder, my son, without any assistance from me, traced the words, contracted, manꝫ. mur. mur., which will be immediately read by any Irish scholar as Manus, Muirchertach Muirchertach; that is, Manus and two Murtoghs. These names are placed under the three skeleton figures respectively, and very faint traces of another short word

remain, extending to the nearest of the living or clothed figures.

"The whole of the inscription is in the black letter of the close of the fourteenth century.

"There stood, until lately, an altar tomb in the niche adjoining this, further on from the great altar, with the following Irish inscription (also in black letter), which I quote from the 'Tribes and Customs of Hy-Many,' edited by Dr. O'Donovan for the Irish Archæological Society (page 105).

Do muleachlainn ó ceallaiḋ, do ri o maini, ocus d' inbualainn ingen i chonchuir, do rini matha o anli in leachdaigseo.

For Malachy O'Kelly, for the King of O'Many (or Hy-Many), and for Inbualai (Finola), the daughter of O'Conor, Matthew O'Hanly made this monument.

"Over the place occupied by this tomb of O'Kelly and his wife may still be seen, distinctly enough, traces of the same kind and style of painting as that of the O'Conors, in its neighbourhood, and it is more than probable that both were put up at the same time by O'Eddichan, who seems to have been a painter, whilst O'Hanly appears to have been nothing but a mason. It would also appear, that the O'Kelly tomb, not having the universal or do, &c., on it, was set up during his and his wife's lifetime, and decorated, as well as the tomb of the O'Conors, the royal ancestors of Mrs. O'Kelly, by O'Eddichan. The erection and decorations must be very close to the year 1400, as O'Kelly was slain in 1401, and his wife died in 1403, according to the following entry in the Annals of the Four Masters of that year:—

"'A. D. 1403. Fionnghuala (Finola), the daughter of Turlogh, son of Hugh O'Conor, and wife of Melaghlin O'Kelly, Lord of Hy-Many, died, after a virtuous life.'"

"How the lady descended from the three whose names are in the upper line, I have not at present time to inquire, but that she was of their line is, I think, implied in the fact of her decorating their tomb. In all the lines of the O'Conor family I can find but one set of names to agree in succession with the inscription; and they were apparently successors in the same line; here they are from the Annals of the Four Masters:

"'A. D. 1293. Manus O'Conor, King of Connaught, a warlike and valiant man, the most victorious, puissant, and hospitable, of the Irish of his time, died, having been ill a quarter of a year.'

"'A. D. 1294. Murtogh, the son of Manus O'Conor, the best *materies* of a provincial king of all his tribe, was slain by Teige (O'Conor), and Donell, the son of Teige.'

"'A. D. 1368. Murtogh, son of Murtogh O'Conor, died.'"

The two monuments here described by Mr. Curry had been, one perfectly, the other partially, deciphered fifteen years ago by Dr. O'Donovan, then engaged in the historical department of the Irish Survey. His letter, dated 13th September, 1838, is preserved in the singularly interesting collection of letters now at Mountjoy Barracks, in the Phœnix Park. Through the kindness of Major Larcom, Dr. Todd was permitted to peruse the volume containing the letter alluded to, and has extracted the following account of the inscriptions in question:—

"I made every search for inscriptions in this Abbey, but found only four, two painted in fresco on the wall, and two inscribed on stones. On a stone inserted in the wall, at the right-hand side of a tomb, which looks like a small place for an altar, in the choir of the Abbey, is the following inscription:—

Do Mhuleachlaind O'Ceallaid
Do | muleachlaind | okeallaid

Do Ri O'Mani agus d'indhualaind
do | rí | omaní | agas | dindbua

ingen | i-chonchúir | do rine
laind | ingē | ichonchuir | do rine

Macha | O'Cogun | in leabaig | sea
matha | ocogu | in leabaig | sea

" 'For Muleachlaind O'Keallaid, for the King of Hy-Mani, and for Finola, the daughter of O'Conchuir, Mathew O'Cogū made this bed.'

" The two inscriptions in fresco on the wall are so obliterated that I could not make sense of them. The wall is damp and very much stained, and there is a black scum raised on it by the dropping down of the rain. Mr. Petrie has copied the figures on this wall; perhaps he has also attempted to decipher the inscriptions at their feet. If the wall were carefully washed on a summer's day, and then permitted to dry, a person skilled in inscriptions of the age to which these belong, could certainly read a great part of these inscriptions, but without washing the wall it would be impossible to make any sense of them.

" I cleaned a part of the wall, and deciphered a part of the inscription under the hostage pierced with arrows.

pro āīā Malachie
Cah p āīā Malachie

I think it refers to Malachy O'Kelly, for whom the other monument was inscribed. Has Mr. Petrie deciphered this inscription?

" I cannot forget O'Brien's notice of the figures on this wall. He makes the building a ruin of a pagan temple repaired into a monastery in the twelfth century by Charles the Redhanded, King of Connaught, and the archers represent the *longé jaculans Apollo !*"

Having quoted this account of the inscriptions from Dr. O'Donovan's letter, Dr. Todd proceeded to speak, first, of that on the tomb of Muleachlaind O'Kelly, and his wife Finola. It appeared that Dr. O'Donovan, in his Tribes and Customs of Hy-Many, gave a different reading of the inscription from

that which he had previously made out from the stone itself in his letter to the heads of the Ordnance Survey. In the former he reads o anli as the name of the artist; in the latter, ocoᵹū, or *O'Cogan;* in the former he reads leachdaiᵹ ꞅea *this stone;* in the latter, leabaiᵹ ꞅea, *this tomb* or *sepulchre.*

Fortunately, the stone itself had been sent up to the Exhibition, and Dr. Todd was enabled to present to the Academy an accurate rubbing of it, made by Mr. Joseph Huband Smith. From this it appears that, as far as the name of the artist is concerned, both readings are wrong, and that the name is really *O'Cogli,* or *O'Cogley.* It is evident, also, that the three concluding words of the inscription are not, *in leachdaig sea;* but, *in leabaig sea,* and that Dr. O'Donovan had deciphered them correctly in his letter just quoted, although, in his work on the Tribes and Customs of Hy-Many, he adopts the erroneous reading, *in leachdaig sea.*

It may be mentioned incidentally that this unquestionable instance of the use of the word leabaiᵹ (*lit.* a bed), to signify a tomb, or monumental gravestone, is interesting in reference to another antiquarian controversy. It is known to many of the Academy that this word leabaiᵹ, or the synonymous liᵹe, is the name given by the peasantry in every part of Ireland to the monuments which have been called *Druids' altars,* proving evidently they were regarded in our national tradition, not as altars, but as tombs, and thus confirming the opinion so ably maintained before this Academy by Dr. Petrie (in a Paper which, it is to be regretted, has never been published),—an opinion which is now adopted generally by English and European antiquarians, although some of our learned brethren in Wales still cling to the altar hypothesis.

The Muleachlaind or Maelseachlainn O'Kelly, mentioned in the inscription, was the twenty-ninth in descent from his great ancestor Maine Mor, and became what was called king or chief of Hy-Many, in 1375. He married, first the daughter of Walter Burke, by whom he had three sons, Rory, Brian, and Conor; and, after her death, Fianguala, or Finola,

daughter of Turlogh O'Conor, by whom he had seven sons. The inscription, now before the Academy, seems to settle the question raised by O'Farrell in his Linea Antiqua, as to whether Finola, or the daughter of Walter Bourke, was his first wife. And it is confirmed by the testimony of the Book of Lecan, and by the fact recorded by the Four Masters, that Finola survived her husband two years, Melachlin having died in 1401, and Finola in 1403.*

These dates, as Mr. Curry has observed, fix the date of the inscription, as well as of the fresco painting; and this conclusion is fully established by the form of the characters in which the inscriptions on both monuments are written; they are manifestly the black-letter characters of the end of the fourteenth and beginning of the fifteenth century.

It is a singular proof of the ignorance or carelessness of the antiquaries of the last century that Ledwich should have ascribed this inscription to the thirteenth, and that on the fresco painting to the seventeenth century, although they are manifestly in characters of the same date. One may indeed fairly doubt whether he had ever seen either inscription, although he did not scruple to dogmatize as to their date. With respect to the inscription on the fresco, he makes no attempt to read it, either in the text of his work or in the very inaccurate engraving which he gives of the whole painting, where, though he marks the position of the inscription, he evidently represents it as illegible.

But Mr. Curry infers from the omission of the usual form: "PRAY for Mealachlain, &c.," at the beginning of the inscription, and from its being only said that the stone was erected to, or to the honour of, the chieftain and his wife, that they were living when it was put up. Of the erection of monumental inscriptions, during the life of the parties mentioned in them, there are many examples; and, in the present in-

* O'Donovan's Hy-Many, p. 107.

stance, it is rendered the more probable that such was the case from the space left at the end of the inscription, apparently for the insertion of the date of their deaths. If this conjecture be correct, it will follow that the monument must be older than the year 1401, and the troubled state of the country at that period will sufficiently account for the fact that the inscription after the death of the parties to whom it relates was never completed.

Dr. Todd next directed the attention of the Academy to the fresco painting, where the principal inscription, imperfectly read by Dr. O'Donovan in 1838, but now completely restored by Mr. Curry, asks the reader to pray for the souls of Malachy, of Finola, and of Conor O'Eddichan, who caused the monumental fresco to be made. The last word is somewhat doubtful; it may be either *fecit*, in which case Conor O'Eddichan would appear to have been the artist, or a contraction for *fecerunt*, in which case we must infer that Malachy, Finola, and O'Eddichan united in getting the fresco executed. The former is probably the true reading.

The fac-simile of the fresco which had been executed for the Committee of the Great Exhibition was hung up upon the wall of the meeting-room of the Academy, and Dr. Todd proceeded to make the following remarks upon it:—

There can be very little doubt that the Finola mentioned in it was the same Finola ni Conchubhuir, who was married to the O'Kelly, and whose name occurs in the former inscription; and Malachias is beyond all question the Latinized form of her husband's name, Maelseachlain. If so, this painting was executed after their deaths, as it begins, *Ora pro animabus*, and Conor O'Eddichan was probably the artist; it must, therefore, be dated in 1403, or soon after. The stone was probably placed on the spot where they were actually married, and the fresco painting on the nearest wall that was found large enough for the purpose.

The fresco is divided into two subjects. On the upper

part of the wall is the first subject, representing three crowned skeletons, and three crowned figures draped, of whom two bear hawks in their hands, and the third holds a naked sword. On the lower part, to the left, is a figure of the Almighty, represented, as was then usual, in the form of an aged man, with flowing beard; on his breast a dove and large-sized crucifixion; of this, however, slight traces only now remain; the dove and crucifixion have been destroyed, probably by the Cromwellians or Puritans, to whom this mode of representing the Deity was peculiarly offensive. The plaster has in fact been entirely removed from the centre of the figure; an hence some have supposed that it represented not the Almighty, but a Brehon, holding in his left hand a book. What was taken for a book, however, is probably the remains of the left arm of the cross, and Dr. Todd was of opinion that the former is by far the more natural interpretation of the picture. On the right hand of this figure is an angel holding the balance of judgment, and on his left are two archers shooting at a naked figure, who stands between them, tied to a tree, and in whose body several other arrows are sticking, an evident representation of the martyrdom of St. Sebastian.

It has been objected that St. Sebastian does not appear to have been known in Ireland, as his name does not occur in the martyrology of the Four Masters, which was compiled by those eminent scholars from all the then extant sources of Irish Hagiology. And hence it is inferred that the execution represented in the fresco is not what it would appear at first sight to be, but an event of Irish history, the death, namely, of the hostages of Dermot Mac Murchadha, who were executed on the bridge of Athlone by Rory O'Conor, King of Ireland, A. D. 1170. To this conjecture, however, which was first suggested by Ledwich, and has been lately adopted by a much higher authority, there are serious objections. In the first

place there seems no reason why, in 1403, an event of such ancient date should be represented in a religious picture at the tomb of Malachy O'Kelly and his wife, individuals who had no other connexion with the event than that the O'Conor, who presided over the execution, was one of her remote ancestors. But secondly, the Four Masters tell us that there were three victims put to death on this occasion, namely, Diarmaid, the son of Mac Murrough, heir apparent to the throne of Leinster, his grandson, the son of Donnell Cavanagh, and the son of his foster-brother, O'Caellighe. The picture, however, represents only a single victim, and therefore accords more nearly with the martyrdom of St. Sebastian than with the death of Mac Murrough's hostages; the figure, moreover, being a naked one, according to the usual representation of St. Sebastian, without any symbol of rank, or other token, which would most probably have been added if the son of Mac Murrough had been intended. Moreover, the fresco, as the inscription shows, was evidently a monumental picture, painted on the walls of a church, in the very chancel, and consequently with a religious and devotional object; it is much more likely, therefore, that it should depict the martyrdom of a saint than a barbarous execution, more than two centuries old, with which neither the individuals whose tomb it decorated, nor the clergy of the abbey, had any special reference. Nor is it the fact that St. Sebastian's story was unknown to the ancient Church of Ireland; for although the name of that saint does not occur in the martyrology of the Four Masters, which is exclusively confined to Irish saints, yet it does occur under the form *Sapaist*, in the older martyrology of Aengus, at the 20th day of January, the very same day on which his memory is celebrated at Rome. We find his name also in the martyrology of Bede, and in all the Calendars of the English and Anglo-Irish Churches, long before the times of Maelseachlain O'Kelly and his wife Finola. See, for ex-

ample, the Calendar prefixed to the Book of Obits of Christ Church Cathedral, Dublin, published by the Archæological Society from a MS. of the thirteenth century.

It remains now to notice the words which appear under the three skeleton kings, in the upper part of the picture, which Mr. Curry reads, manꝫ. mur. mur., and interprets them as contractions of the names *Manus*, *Muirchertach*, *Muirchertach*.

If we regard them as the names of three departed kings of Connaught, of the O'Conor dynasty, it is not easy to fix exactly the persons who are intended. The Four Masters, in 1293, record the death of Manus O'Conor, king of Connaught, an event which was the beginning of a long series of fatal conflicts. His son was named Muirchertach, and this would lead us at first sight to think that we had found two at least of the skeleton kings of the painting. But we are at a loss for a second of the name; and even this Muirchertach does not appear to have ever succeeded to his father's kingdom, for his murder, by Teige O'Conor and his son Dermot, is recorded in the annals at the very next year, 1294. Still, however, he may have been represented by one of the skeletons of the fresco, inasmuch as he was the lawful heir of his father, adḃar coiccedaiġ do bḟearr da ċined, as he is called by the Four Masters.

His second son was named Manus, and was killed in 1315, where he is called by the Four Masters the most famous and illustrious of the princes of Connaught; so that if the names on the fresco were Manus, Murtogh, and Manus, there would be a high probability that the three skeleton kings represented the extinct line of Manus O'Conor and his two sons, who, although kept from their rights by the superior power of their rival, were nevertheless, *de jure*, the heirs to their father, and were doubtless regarded by many as the legitimate chieftain. It is therefore a question worth inquiring into, whether Mr. Curry has correctly deciphered this

part of the inscription, and whether the names are not really manȝ. mur. manȝ. The great injuries which the painting has received render it not impossible, notwithstanding Mr. Curry's usual accuracy, that he may have mistaken the latter word, especially as it appears from his letter that this part of the inscription was read for him by the less experienced eye of his son.

On the death of Manus, we are told by the annalists that Aodh, son of Eogan O'Connor, was made king by the influence of the English Lord Justice or Viceroy, and was maintained in his place by the English interest for many years, and amidst various contests and vicissitudes. At one time he was taken prisoner by Fitzgerald, and Cathal Roe O'Conor took the kingdom; but three months afterwards Cathal was murdered by a near relative, and Aodh returned to power. In 1296, however, we find that Aodh, who had hitherto relied on English support, was deposed by his own tribe, and the Clan Murtough brought in to fill the throne in his place, in the person of Conor Roe, son of Cathal O'Conor. If the correct reading of the inscription, therefore, be *Manus*, *Muirchertach*, *Muirchertach*, as Mr. Curry gives it, it is not impossible that the second *Muirchertach* may be intended to stand for this new dynasty of the Clan Murtogh, which derived its name from Muircheartach Muimhneach O'Conor, who died in 1210, and was the son of the celebrated Turlogh Mor O'Conor, King of Ireland from A. D. 1106 to 1156. The Clan Murtogh, however, continued but a short time in power: their necessities probably led them to pillage the churches and to seize upon the property of the laity. They lost their popularity, and Aodh was restored by the aid of the English and of the Burkes,— "God, the Virgin Mary, and Columbkille," say the Four Masters, "having taken vengeance on the Clan Murtogh for despoiling their churches:" and thus Aodh continued in power, and this time apparently with the consent of his tribe,

being still supported by the English, until 1309, when he was slain by Aodh Breifneach, the representative and head of his rivals of the Clan Murtough, who the very next year was, in his turn, treacherously murdered, and the line of Aodh returned to power in the person of his son Feidlimidh.

All this, however, was the history of the century previous to the times of Mealseachlain O'Kelly and his wife Finola, and there does not appear any sufficient reason why this particular series of events should have been represented in the fresco, except that Finola appears to have been the granddaughter of Aodh, son of Eoghan O'Conor, whose history has just been given. And this seems to suggest another reason against the supposition that the execution of Mac Murrogh's son and hostage is the event portrayed in the fresco; for Aodh, son of Eoghan, grandfather of Finola, had been raised to the throne, and maintained there, in opposition to the power of the Clan Murtogh, by the interest of the English. It is not probable, therefore, that the barbarous murder of Mac Murrogh's son, which marked such extreme hostility to the English on the part of the O'Conors, should have been the one event of Irish history selected for the decoration of her tomb. She too, and probably her husband, was more likely, like the rest of her family, to have been in the interest of the English.

It must be admitted, however, that we have no sufficient explanation of the three draped and crowned figures in the upper part of the picture. That on the left, it should be observed, is bearded, and evidently represents a personage older than the other two, who are of youthful appearance, especially the figure bearing the naked sword on the extreme right. It is possible, however, that these may represent the line of kings in actual possession; but why they are limited to three does not very clearly appear. It may be stated as a conjecture, which Dr. Todd stated that he threw out merely as a subject for further investigation, that there seem to have been three kings

of the race to which Finola belonged, as well as three of the extinct race of Manus. If so, the draped figures will represent the three royal ancestors of the wife of O'Kelly: viz., Aedh, son of Eoghan, her grandfather, who was slain in 1309; Feidlimidh, his son, who reigned six years, and was slain in the great battle of Athenry in 1316, at the early age of 23; when his rival Ruaidhri or Rory na bfedh (or of the Faes, a territory near Athlone, where he was fostered), one of the Clan Murtogh, took the throne and held it until he was murdered by Cathal, the son of Aodh, in 1321, who then succeeded his brother, and is probably the third of the draped sovereigns; for in 1324 we find another Cathal, of the Clan Murtogh family, styled King of Connaught by the annalists.

The conjecture, therefore, which Dr. Todd threw out as to the meaning of the figures is, that the three skeleton kings represent the extinct race of Manus O'Conor, who died in 1293, and that the draped and living kings represent the three regal ancestors of Finola: viz., Aodh or Hugh, son of Eoghan, who succeeded in 1293; Feidhlimidh, his son, who succeeded in 1310; and Cathal, another son, who appears to have succeeded in 1321.

It is to be understood, however, that this is a mere conjecture, intended to attract the attention of Irish scholars to the subject, in the hope that the investigation of it may lead to the fuller elucidation of a very obscure period in our history. It may be observed, that the Irish names under the skeleton figures forbid us to suppose the upper part of the picture to have any relation to the martyrdom of St. Sebastian, and fully justify us in assuming that this portion of the fresco has relation to Irish or family history.

NOVEMBER 30th, 1853. (Stated Meeting.)

THOMAS ROMNEY ROBINSON, D. D., PRESIDENT, in the Chair.

RESOLVED, on the recommendation of the Council:—

1. That the election of Honorary Members shall take place only at the Stated Meeting in March, instead of in November, as determined by the Academy in the regulations for the election of Honorary Members adopted on the 11th of January, 1847.

2. That the Academy do authorize the expenditure of a sum not exceeding £50 for the purchase of photographic apparatus for the use of the Academy.

The Secretary read a letter from Lord Talbot de Malahide, presenting the following articles, which were lately exhibited in the Archæological Court of the Great Industrial Exhibition:—

From Dr. Daniel Wilson, late Secretary to the Society of Antiquaries of Scotland, Plaster Casts of—

1. Bronze circular shield, decorated with a classic group in low relief.

2. "Horn of tenure," richly carved in ivory. It formerly belonged to Dr. Samuel Hibbert Ware.

3. Chessman, carved out of walrus tooth, found in the Isle of Skye.

4. Bronze armilla, snake pattern, found at Pitalpin, near Dundee, in 1732.

5. Bronze armlet, dug up in Argyleshire.

6. Bronze armlet, found in a cairn in Aberdeenshire.

7. Fragment of a pastoral staff made of oak, found in the tomb of Bishop Tullock, Kirkwall Cathedral, Orkney.

Electrotypes of—

8. A gold sceptre head, found at Cairnmure, Peebleshire, in 1806, along with three torques and other gold relics.

9. Head ring, or gorget of bronze; found in 1747, about seven feet below the surface, when digging a well at Stitchel, Roxburghshire.—(See Official Catalogue, No. 1903.)

From Lord Talbot de Malahide, fac-similes in copper of bronze weapons found on the property of the Hon. H. T. Liddell, in the county of Northumberland, viz.:

10. A very large spear, with perforated blades; length, 19 inches; breadth, 3·5 inches.

11. A large spear, quite plain; length, 14·8 inches; breadth, 2·5 inches.

12. A javelin head, length, 7·9 inches; breadth, 1·4 inches.

13. The blade of a sword, with remains of handle, similar to those found in Ireland, length, 22·1 inches; breadth, 1·6 inches.

14. A sword, with hollow handle, balanced with a manilla, or piece of ring money, length of blade, 15·8 inches; breadth, 1·4 inches.

From Albert Way, Esq., casts in copper of the following bronzes:—

15. A half mould for casting a flat celt or palstave, with a lateral loop.

16. A half-mould for casting palstaves. The originals of these were found in 1800 in Danesfield, near Bangor, with a bronze palstave, but it had not been cast in either of the moulds. The original moulds were given by William, Bishop of Bangor, to the Marquis of Buckingham; and at the Stowe sale one moiety of each mould was purchased by the Hon. Richard Neville, and are in the Museum at Audley End; the others were purchased for the British Museum.—(See Archæological Journal, vol. vi. p. 386.)

17. A spear-head, with expanding blades; length, 11·8 inches; breadth, 1·9 inches.

18. A spear-head, with broad blade contracting towards point, length, 12·4 inches; breadth, 2·2 inches. The originals of these were found in Greece, and are now in the possession of the Hon. Robert Curzon, Jun., Sussex.

Cast, in metal, of a large armlet, now in the British Museum, made of copper or bronze, ornamented with red and yellow enamel; found with another of the same kind at Drummond Castle, Perthshire. Presented by Alexander Nesbitt, Esq., London.

Specimens of a curiously tied cloth, made of vegetable fibre, not unlike new Zealand matting; with portions of woollen binding and thread; found in a deep cutting in a turf bog in the county of Cavan. Presented by Christopher Fleming, M. D.

A large mass of iron conglomerate, composed chiefly of fine chain mail and sand; discovered about nine miles south of Coleraine, in the bed of the lower Bann River. Also an iron sword, found further down the same ford of Carnroe. Presented by Charles Ottley, Esq., as an addition to the collection of Antiquities made by the officers of the Drainage Commission.

Dr. Ball exhibited two specimens from the collection of T. L. Cooke, Esq., of Parsonstown. One of them, he considered, indicated the original form of the object called a Crotal, to which he had drawn attention on a former occasion;* and though the other resembled the former in shape, it appeared to be intended for some other purpose than merely making sound.

Rev. Dr. Graves remarked, that it was improbable that any of the class of objects referred to were Crotals; on the contrary, he believed they were a species of clasp, from their

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* See Proceedings, vol. iii. p. 135.

general similitude to a peculiarly shaped fibula found in some ancient burial-places in France.

The President read the following paper on the construction of the Cassegrain Telescope:—

"It is probably known to the Academy that an application has been made to Government, under the auspices of the Royal Society and the British Association, for the establishment of a large reflector in some convenient part of the British dominions, and its employment on a complete survey of the southern nebulæ. In the course of the discussion which preceded this application, the construction of the telescope was an object of some importance, and I suggested that it might be desirable to try the Cassegrain: this was thought deserving of attention, and, in the hope that it may be acted on, I offer some rules for determining the dimensions of its parts, which will not be unimportant in so gigantic an experiment. They were investigated by me many years ago, when directing the arrangements of that which Mr. Grubb constructed for the Armagh Observatory. It is 15 inches aperture, and its performance is such as to justify an expectation that this form may be made of much greater magnitude.

"The Cassegrain has been little used; in fact, I know but of two, besides that referred to, which have been made of larger aperture than 6 inches: one of 18 inches by Lord Rosse, who, however, uses it as subsidiary to his larger telescopes, and has not given special attention to its improvement. The other was made by the elder Tulley about 1800: it was 15 inches aperture, and 7 feet focus; but it appears to have been indifferent; for, according to the notes of William Walker (a competent judge) it 'showed Rigel like a shilling, and the companion was not seen at all.' At that time, however, the proper method of supporting the great speculum was not known.

"The cause of this neglect is perhaps the severe criticism of it which Newton made at the time of its invention: as compared to his telescope it is in some respects inferior, though on other grounds than those commonly assigned; but in others it is superior. The defects are—

"1. In large instruments it is difficult to keep the magnifying power sufficiently low, the second image being five or six times as large as what is due to the focal length of the great speculum; and this is essential, because the air is seldom so calm as to admit, with large apertures, of using powers proportional to those of lesser instruments.

"2. The rays have to pass thrice the length of the tube, while in the equivalent Newtonian it is twice the length: the tube is, however, shorter in the first instance, so that the actual spaces are as 1 : 1·28. As there is almost invariably a difference of temperature between the great speculum and the air in the tube, the latter is affected with eddies and currents, which cause indistinct vision in proportion to the quantity of disturbed medium which the rays traverse.

"3. The small mirror is larger than in the Newtonian, and therefore stops a little more of the central rays.

"It was also objected by Newton that the field of view must be small, and that the reflection is more intense in the incidence of 45 on his small mirror, than at the perpendicular.

"Of these the greater length of the light path is the only valid objection, and even this may probably be made less potent by establishing a downward current in the tube, or by apertures in it, to let the heated air escape freely. The magnifying power can be such as just to allow of the eye taking in the whole pencil, below which one cannot go without giving up part of the advantage of an instrument's size. The field can be quite as large as in the Newtonian. The loss of light by the difference of the small mirror is insignificant, the more so as the central rays are really the least valuable of all:

indeed even with achromatics we find that sometimes a difficult object is best seen when the central part of it is covered. The reflection at 45° *from metal* is, in fact, a little fainter than the perpendicular one, from which incidence its intensity decreases slowly till it becomes a minimum between 60° and 70°.

"The advantages of the Cassegrain are:—

"1. The tube is shorter.

"2. The observer is near the ground; he can easily be sheltered, and the eye-piece travels in a sphere of small radius: while with the Newtonian he requires a complex apparatus to support him, expensive and bulky.

"3. Any error of the large speculum can be corrected by figuring the small one to meet it. This, which was long since pointed out by Ramsden, is of much importance in large instruments; for it is far easier, if the large speculum has not been perfectly figured, to let it abide, and work the other to it, having a few inches' aperture, and weighing a few pounds, than to dismount and move one of a couple of tons,—the more so as as the control which is had over the process of polishing is very much greater in the first case. I say this from experience; for the great speculum of the Armagh was made parabolic, that it might be used as a Newtonian, and the other was worked to correspond to it, as while spherical it gave but an indifferent definition.

"4. If the curvature of the second image be compared with the greater focal length of the ocular part which is required to give the same magnifying power, it will be found that the field is flatter with the single lens, or Huygenian eyepieces, than in the Newtonian.

"5. The second image is so much larger than the primary one as to afford much facility for micromatic measurement.

"6. The adjustment of the specula is more easily verified.

"These seem to me sufficient to invite the attention of any who are engaged in the construction of large telescopes to

this form, and to make it desirable that its principles should be developed more fully than is done by the existing treatises on Optics. Their formulæ do not include the magnitude of the emergent pencil, or the distance of distinct vision, the latter of which I noticed in a former communication as an element of magnifying power, and both of which are important in this inquiry.

"The data are—

"(*a*) The eye must take in the whole pencil of rays which the great speculum received from the point which is examined, and which I assume to be on its axis. This diameter cannot exceed the maximum aperture of the pupil, which Sir W. Herschel determined to be two-tenths of an inch, or, taking the foot as unit, $\frac{1}{60}$.

"(*b*) The small mirror must receive the whole of the central pencil: if its magnitude be only sufficient for this it loses a little of the oblique pencils, but not enough to lessen the brightness materially. In a field of 10′ the edge will be about one-ninth less bright than the centre.

"(*c*) The eye must be distant from the last image, real or virtual, by the quantity V, in order to have sharp vision. This distance was formerly assumed = 8 inches, but is less: the mean of my eyes, of my two assistants, and another individual, gives it = 6·42; Sir David Brewster makes it as low as 5, but I think it may be taken 6, or 6·5.

"(*d*) The first lens of the eye-piece (and the aperture in the great speculum) should have the same diameter as the small speculum for the lowest power; if less, it contracts the field of view; if larger, it lessens the effective surface of the great speculum. Hence the last ray is parallel to the axis.

"(*e*) The last image must be near the hinder surface of the great speculum box, in order to apply a micrometer. The distance between this and the surface of the speculum is about one-fifth of its aperture.

"Let F, f', f'' be the focal lengths of the specula, and

the first lens, A, a, a', their apertures; d and d' the distances of the first and second images from the second speculum; M the magnifying power, and θ the field of view: we have $a' = a$, and from

$$d = \frac{Fa}{A}.$$

The parallelism of the bounding ray gives

$$\theta' = \text{cotan } 1' \times \frac{ad}{d'} = \text{cotan } 1'. \times \frac{a^2}{Ad'}.$$

"The simplest ocular arrangement is to view the last image with the unaided eye. As, however, this telescope requires an eye-stop, or aperture, placed so as to transmit no light except what comes from the small mirror, a lens must be used to form an image of that at the stop. This lens will also form an image of the second image. Let ϕ be the distance of the second image behind the lens, u that of the third image in the same direction, u' that of the image of the small mirror, and x the section of the central pencil at the eye-stop:

$$u = \frac{\phi f'}{\phi + f'}; \quad u' = \frac{f'(d' - \phi)}{d' - \phi - f'}; \quad x = \frac{aV(\phi + f')}{d'f'};$$

$$M = \frac{A}{Va} \times \frac{\phi + f}{f} = \frac{A}{x}.$$

The condition of distinct vision gives

$$V = u' - u;$$

whence

$$\phi^2 - \phi(d' - 2f') = -f'^2 - f'd'.$$

Developing which, and omitting terms affected with $\frac{1}{d'^3}$, and upwards,

$$\phi = f' + \frac{4f'^2}{d'};$$

combining which with the value of x, we obtain a value of d'. This quantity is also in general

$$= F + \frac{A}{5} - \frac{Fa}{A} + \phi - u;$$

and as a, the aperture of the lens, is, according to the usual practice of opticians, $= \frac{1}{8}f'$, we derive

$$a\left(62{\cdot}763 + \frac{F}{A}\right) - 0{\cdot}18823a^2 - 0{\cdot}00394\, a^3 = F + \frac{A}{5}.$$

The proposed reflector is to have $A = 4$ feet; and if we make $F = 9A$, which is Lord Rosse's proportion; we shall find $a = 0{\cdot}5135$, or 6·16 inches.

"From this follow $f = 5{\cdot}38$, $f' = 1{\cdot}03$, $d = 4{\cdot}62$, $d' = 32{\cdot}74$; the distance of mirrors $= 31{\cdot}38$, $M = 240$; and $\theta = 6'{\cdot}92$. The field of view is too small, but the arrangement may be convenient from the sharpness of vision obtained with the single lens.

"From what has been stated as to the power of correcting the figure of the large speculum by the small one, it does not seem necessary that F should be so great; in the Armagh telescope it is only $7{\cdot}5A$, and may be $8A$. On this supposition we find

$$\begin{array}{llll} a = 0{\cdot}4641 = 5{\cdot}57 \text{ inches.} & & & \\ f = 4{\cdot}24. & & & \\ f' = 0{\cdot}93. & & M & = 240. \\ d = 3{\cdot}71. & & \theta & = 6'{\cdot}25. \\ d' = 29{\cdot}59. & & & \end{array}$$

Distance of mirror $= 28{\cdot}29$.

The Huyghenian eye-piece is much to be preferred in this case. In it $3f'' = f'$, and the distance of the lenses $= \frac{2}{3}f'$. This combination, it must be remembered, is not achromatic unless the rays emerge parallel, but where the lenses are so large as they are here, the colour is scarcely perceived. Denoting, as before, by ϕ the distance of the second image from the field-glass; by u and z the distance of the two succeeding images from the lenses which form them; by u' and z' those of the images of the small speculum, the last of which is at the eye-stop, we have

$$u = \frac{\phi f'}{\phi + f'}; \quad z = \frac{f'}{3}\left(\frac{2f' - \phi}{2\phi - f'}\right); \quad u' = \frac{f'(d' - \phi)}{d' - \phi - f'};$$

$$z' = \frac{f'}{3}\left(\frac{d' - \phi + 2f'}{d' - \phi + f'}\right); \quad x = \frac{aV}{d'} + \frac{2\phi - f'}{f'}.$$

The condition of distinct vision gives $V = z + z'$, whence is derived

$$2\phi = d' + f' - \sqrt{\left(d'^2 - \frac{f'^2 d'}{V}\right)}, \text{ or nearly } = f' + f'^2 + \frac{f'^2}{2d'};$$

using which in x, and setting $2a$ for x, we have

$$d'^2 - 60a^2 d' = 120a^4.$$

Equating the value of d' given by this to its general one, we have

$$\left(\frac{F}{A} - \frac{1}{3}\right)a + 60{\cdot}790a^2 - 0{\cdot}63151a^3 + 0{\cdot}43461a^4 - 0{\cdot}29979a^5 + \&c.$$
$$= F + \frac{A}{5}.$$

With $F = 9A = 36$, this gives

$a = 0{\cdot}7115 = 8{\cdot}54$ inches.
$f = 8{\cdot}02$.
$f' = 1{\cdot}423$. $\quad M = 240$.
$d = 6{\cdot}40$. $\quad \theta = 13'{\cdot}88$.
$d' = 31{\cdot}34$.

Distance of mirror $= 29{\cdot}60$.

With $F = 8A = 32$ we have

$a = 0{\cdot}6760 = 8{\cdot}11$ inches.
$f = 6{\cdot}68$.
$f' = 1{\cdot}35$. $\quad M = 240$.
$d = 5{\cdot}41$. $\quad \theta = 13'{\cdot}88$.
$d' = 28{\cdot}30$.

Distance of mirror $= 26{\cdot}59$.

In these the field is as large as can be obtained with this power in any telescope without a triple eye-glass.

"The Newtonian does not require the same exactness in its arrangement, but I add the formula for it. The data are, that the image must be outside the tube, distant from the axes $\frac{1}{2}A + m + \phi - u$; m may be neglected if the tube be iron; the eye must receive the whole pencil; and the eye-stop, placed at the image of the large speculum, must be V distant from the last image of the object. With a single lens, calling $2b$ the axis minor of the small speculum,

$$u = \frac{f'\phi}{f - \phi}; \quad u' = \frac{f'(F + \phi)}{F + f' + \phi}; \quad x = \frac{AV(f' - \phi)}{Ff};$$

$$2b = \frac{A}{F}(\tfrac{1}{2}A); \quad \theta = \text{cotan } 1' \times \frac{1}{F}\left(a + \frac{\phi(2b - a)}{\frac{A}{2} - b - \phi}\right).$$

The condition of vision is

$$V = u + u',$$

whence

$$\phi^2 + F\phi = f'(F + f') - f'^2\frac{(F + 2f')}{V};$$

and the expression of x gives

$$\phi = f'\left(1 - \frac{F}{6AV}\right),$$

whence

$$f'^2 + \frac{f'}{4}\left(2F - \frac{F}{15A} + \frac{F^2}{900A^2}\right) = \frac{F^2}{120};$$

which for $F = 36 = 9A$ gives

$$\begin{aligned} 2b &= 0{\cdot}2222 = 2{\cdot}67 \text{ inches.} \\ f' &= 0{\cdot}1575 = 1{\cdot}89 \quad ,, \\ M &= 240. \\ \theta &= 8'{\cdot}37. \end{aligned}$$

For the Huyghenian the formulæ given for the Cassegrain apply, changing d' into F, and a, when it belongs to the small speculum, to A:

$$2b = \frac{A}{F}\left(\frac{A}{2} + \phi - u\right); \quad \theta = \frac{\text{cotan } 1'}{F}\left(a - \frac{\phi(2b - a)}{\frac{A}{2} - b - \phi}\right).$$

We thus obtain

$$f'^2 + 2Ff' = \frac{F^2}{15A}; \quad \phi = \frac{f}{2}\left(1 + \frac{F}{30A}\right);$$

whence

$$2b = 0{\cdot}2308 = 2{\cdot}77 \text{ inches.}$$
$$f' = 0{\cdot}2998 = 3{\cdot}60 \quad ,,$$
$$M = 240.$$
$$\theta = 13'{\cdot}46.$$

"The field here is nearly the same as in the Cassegrain; with the single lens it is something larger, which arises from that lens acting differently in the two cases, in that it diminishes the image, and therefore requires an increased value of d'."

December 12th, 1853.

THOMAS ROMNEY ROBINSON, D. D., President, in the Chair.

The Rev. H. Lloyd, D. D., read a supplemental note "on the magnetic influence of the moon."

In a previous communication* the author had shown, from a discussion of the observations made at the Magnetical Observatory of Dublin, that the magnetic declination was subject to a small periodical variation dependent upon the moon's hour-angle, the north pole of the magnet deviating twice to the east, and twice to the west, in the course of the lunar day. It was, of course, to be expected that a similar variation would be found to affect the other two magnetic elements. In order to trace its existence, and to determine its law, in the case of the horizontal component of the magnetic intensity, the author

* Proceedings, May 9, 1853.

has since discussed the two-hourly observations made with the bifilar magnetometer in the years 1841, 1842, 1843, the whole series being re-arranged according to the moon's hour-angle, in the manner already described in the corresponding investigation relating to the declination. No correction has been applied for temperature, the effect of the diurnal variation of temperature being assumed to be eliminated in this mode of grouping the results.

The following Table contains the yearly mean results for the several lunar hours, reckoned from the time of the moon's upper meridian passage. The numbers are the differences between the horizontal intensity at each hour, and that of the entire day, expressed in millionths of the intensity. The results are given for each year separately, and for the mean of the three:—

Table I.—*Diurnal Variation of the Horizontal Intensity related to the Moon's Hour-Angle. Yearly Means.*

Hours.	1841.	1842.	1843.	Mean.
0	− 45	− 7	+ 34	− 6
2	− 130	− 94	− 9	− 78
4	− 57	0	− 18	− 25
6	+ 5	+ 64	− 11	+ 19
8	+ 173	+ 94	+ 55	+ 107
10	+ 116	+ 80	+ 30	+ 75
12	+ 80	− 4	− 2	+ 25
14	+ 62	− 50	− 32	− 7
16	− 100	− 41	− 82	− 74
18	− 80	− 32	− 14	− 42
20	+ 7	− 25	+ 55	+ 12
22	− 27	+ 9	− 4	− 7

It appears from the foregoing Table that the horizontal component of the magnetic intensity is subject to a periodical variation in the course of the lunar day, analogous to that already established in the case of the declination. The hori-

zontal intensity is a *minimum* at about 2 and 16 (lunar) hours, and a *maximum* at about 8 and 20 hours. The mean amount of the fluctuation is 86 millionths of the intensity, when the moon is to the east of the meridian, and 185 millionths, when it is to the west.

The summer and winter lunations yield analogous results. These are given in the following Table :—

TABLE II.—*Diurnal Variation of the Horizontal Intensity related to the Moon's Hour-Angle, in Summer and in Winter.*

Hours.	Summer.	Winter.
0	+ 8	− 21
2	− 104	− 51
4	− 77	+ 27
6	+ 6	+ 32
8	+ 96	+ 119
10	+ 77	+ 74
12	+ 57	− 5
14	+ 9	− 22
16	− 80	− 69
18	− 39	− 46
20	+ 21	+ 4
22	+ 27	− 42

If it be assumed that the total intensity undergoes no change,—or, in other words, that the variation above deduced is produced by a change in the inclination alone,—we can infer the latter. Its law will of course be similar to that of the horizontal intensity, the greatest inclination corresponding to the least intensity, and *vice versâ*. The total amount of the change, on this supposition, is 0′·22, or about one-fourth of the corresponding change of the declination. The magnitude of the change of direction of the resultant magnetic force in the perpendicular plane (= change of declination × cos inclination) is 0′·27.

Rev. H. Lloyd, D. D., read the second part of a paper "on the Meteorology of Ireland, as deduced from the observations made in 1851 under the direction of the Royal Irish Academy."

JANUARY 9TH, 1854.

THOMAS A. LARCOM, ESQ., V. P., F. R. S., &c., in the Chair.

J. Thomas Rosborough Colclough, Esq.; and J. Butler Pratt, Esq., were elected Members of the Academy.

On the recommendation of the Council it was Resolved:—

To insert the following By-Law, between Nos. 6 and 7 of Chap. VII. of the Statutes of the Royal Irish Academy:—

"Donations received and acknowledged."

The Secretary presented, from James F. Bland, Esq., a very exact and beautiful model of that remarkable and curious ancient structure called Staig Fort, situated on the property of Mr. Bland, near Kenmare, county Kerry. The model was made of portions of stone selected from the original building, and constructed on the spot by Messrs. Thomas and William Jermyn, the tenants of the farm on which the Fort stands.

Professor Allman read a paper on the structure of the starch granule obtained from the potato.

The author combated the theory of involution recently proposed by Martin, and modified by Busk; he maintained that the conclusions to which these observers arrived were drawn from incorrect interpretation of the phenomena, and that the appearance of unrolling or unfolding of the granule

under the action of hot water or mineral acids was a purely secondary phenomenon, and dependent on a condition induced in the granule by the action of these reagents. The immediate effect of this action is a swelling up of the granule, but the latter, not at once responding to the action of the reagents *uniformly over its whole surface*, certain portions of the surface are first elevated into ridges or projections, which necessarily leave depressions of greater or less depth between them, and the appearances which have been mistaken for an unrolling or unfolding of the original granule are due to the act of formation of these ridges, but especially to the rolling outwards of the intervening depressions when these, in their turn, almost immediately afterwards, respond to the action of the reagents.

The author believes that there is no difficulty in demonstrating in the most undeniable way the composition of the starch granule out of a series of hollow concentric lamellæ. If potato starch previously exposed to the *prolonged* action of a rather weak alcoholic solution of iodine be treated under the microscope with sulphuric acid diluted with about one-fourth water, the granules will, for the most part, present a beautiful dissection of the lamellæ from one another, which will then be plainly seen to consist of a series of hollow concentric shells. In this experiment a solution was generally employed formed by mixing equal parts of water and the common tincture of iodine; and the granules were exposed to its action for the space of two or three weeks.

The author also maintained, that while the various lamellæ are probably all identical in chemical composition—for they present no difference in their behaviour towards iodine,—they possess, nevertheless decided differences of another kind, which appear to be referable to conditions of integration.

These differences are beautifully demonstrated by the action of acetic acid on the granule, previously slightly iodinized and treated with sulphuric acid; when thus operated on, the

internal layers will be seen to withdraw themselves from the external, in the form first of a wrinkled membrane; and this, gradually contracting towards the centre, the granule will finally appear as a spherical smooth-walled vesicle, with fluid contents, and with an irregular nucleus-like body—the altered internal layers—lying upon some part of the inner surface of its walls.

The author believes, with Schleiden, that the so-called "nucleus" of Fritsche is a minute cavity in the unaltered granule, becoming greatly enlarged by the action of a high heat, as in roasting. The contents of this cavity are rendered blue by iodine, and assume a granular appearance under the action of acetic acid; they are probably fluid or amorphous amylum.

From the appearance frequently presented by the granule under the operation of certain re-agents, and especially during the commencing action of hot water, it would seem to follow that there are definite lines of cleavage in the granule at right angles with the concentric lamellæ.

In conclusion, the author maintained, that the structure of the starch granule, as advocated in the present paper, was much more in accordance with the centripetal than with the centrifugal theory of its growth; but that, while it is to be viewed as really a laminated vesicle, it cannot be properly included in the category of the true organic cell.

Dr. Neligan objected, that if the internal and external coats of the potato starch granule be different in constitution, the chemical test commonly applied to distinguish the different kinds of starch would be inapplicable. Wheaten starch, when triturated slightly, is not as readily coloured by iodine as the starch produced from potatoes, and this seemed to him to be inconsistent with Dr. Allman's theory.

Mr. L. Moore made some observations in reference to the experiments and observations made by Dr. Allman and others who have studied the structure of the starch granule.

The Rev. Professor Graves communicated the following method of solving a large class of linear differential equations by the application of certain theorems in the calculus of operations :—

1. If ϕ and ψ be any functions whatsoever of x, and m and r any numbers, positive or negative, whole or fractional, the symbolic equation

$$\left(D + \phi + \frac{m\psi'}{\psi}\right)\psi^r = \psi^r\left(D + \phi + \frac{(m+r)\psi'}{\psi}\right)$$

holds good for any subject which we may conceive operated on by its two members.

It will be convenient to put

$$D + \phi + \frac{m\psi'}{\psi} = A_m,$$

so that the preceding equation may be written in the form

$$A_m \psi^r = \psi^r A_{m+r}.$$

And operating on this again with the symbol $\psi^{-r}\,(\quad)\,\psi^{-r}$, we get

$$\psi^{-r} A_m = A_{m+r}\,\psi^{-r}.$$

2. It is easy to show that, for λ and μ any functions of x,

$$(D + \lambda)(D + \mu) - (D + \mu)(D + \lambda) = \mu' - \lambda'.$$

Therefore, if χ be any function of x, and m any number,

$$A_m (D + \chi) = (D + \chi)\, A_m + \chi' - \phi' - m\left(\frac{\psi'}{\psi}\right)',$$

whence

$$A_r A_0 (D + \chi) = \left\{(D + \chi)\, A_r + \chi' - \phi' - r\left(\frac{\psi'}{\psi}\right)'\right\} A_0 + A_r(\chi' - \phi').$$

If we now suppose that

$$\chi' - \phi' = c\psi^{-r}, \tag{1}$$

where c is some constant, this becomes

$$A_r A_0 (D + \chi) = (D + \chi)\, A_r A_0 + \left\{2c\psi^{-r} - r\left(\frac{\psi'}{\psi}\right)'\right\} A_0,$$

whence again,

$$A_{2r}A_rA_0(D+\chi)=\left\{(D+\chi)A_{2r}+c\psi^{-r}-2r\left(\frac{\psi'}{\psi}\right)'\right\}A_rA_0$$
$$+A_{2r}\left\{2c\psi^{-r}-r\left(\frac{\psi'}{\psi}\right)'\right\}A_0.$$

But if we further suppose that

$$\left(\frac{\psi'}{\psi}\right)'=k\psi^{-r}; \qquad (2)$$

k being some constant, the last equation assumes the simpler form,

$$A_{2r}A_rA_0(D+\chi)=(D+\chi)A_{2r}A_rA_0+(3c-3rk)\psi^{-r}A_rA_0.$$

And continuing the same process, we should find generally

$$A_{nr}A_{(n-1)r}\ldots A_rA_0(D+\chi)=(D+\chi)A_{nr}A_{(n-1)r}\ldots A_rA_0$$
$$+\left\{(n+1)c-\frac{n(n+1)}{2}rk\right\}\psi^{-r}A_{(n-1)r}\ldots A_rA_0.$$

Or, since by the theorem in § 1 the variable part of the last term is equal to

$$A_{nr}A_{(n-1)r}\ldots A_{2r}A_r\psi^{-r},$$

$$A_{nr}A_{(n-1)r}\ldots A_r\left[A_0(D+\chi)-\left\{(n+1)c-\frac{n(n+1)}{2}rk\right\}\psi^{-r}\right]$$
$$=(D+\chi)A_{nr}A_{(n-1)r}\ldots A_rA_0.$$

3. This last formula enables us to effect the solution of the linear differential equation

$$\left[(D+\phi)(D+\chi)-\left\{(n+1)c-\frac{n(n+1)}{2}rk\right\}\psi^{-r}\right]y=X, \qquad (3)$$

whenever the conditions (1) and (2) are satisfied; as it furnishes us in that case with the means of inverting the operator in the left-hand member. Thus we find

$$y=A_0^{-1}A_r^{-1}\ldots A_{nr}^{-1}(D+\chi)^{-1}A_{nr}\ldots A_{2r}A_rX.$$

4. As regards the conditions (1) and (2), it will be observed, that the latter limits the *nature* of the function ψ, whilst the former makes the difference between ϕ and χ to depend upon that same function.

The solution of the equation

$$\left(\frac{\psi'}{\psi}\right)' = k\psi^{-r}$$

may be obtained by putting $\psi = z^s$ where s is as yet indeterminate; thus it is reduced to

$$s\left(\frac{z'}{z}\right)' = kz^{-rs}.$$

And if we now determine s by making $rs = 2$, we get

$$zz'' - z'^2 = \frac{rk}{2}.$$

Differentiating this again, we find

$$zz''' - z'z'' = 0,$$

the integral of which is

$$z'' \pm a^2 z = 0;$$

therefore,

$$z = (D^2 \pm a^2)^{-1}\,0,$$

and

$$\psi = \{(D^2 \pm a^2)^{-1}\,0\}^{\frac{2}{r}}.$$

5. To exemplify this theory we may assume $\psi = x^m$;

whence $\left(\frac{\psi'}{\psi}\right)' = -\frac{m}{x^2}$, $r = \frac{2}{m}$, $k = -m$, and $\theta - \phi = c_1 - \frac{c}{x}$.

The general formula becomes, therefore, in this case

$$\left\{(D + \phi)\left(D + \phi + c_1 - \frac{c}{x}\right) - \frac{(n+1)(c+n)}{x^2}\right\} y = X.$$

By making $c = 0$, and writing $-m$ in place of n, this becomes

$$\left\{(D + \phi)(D + \phi + c_1) - \frac{m(m-1)}{x^2}\right\} y = X,$$

which is equivalent to a general soluble form which Dr. Hargreave has obtained by an entirely different method.*

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* Phil. Trans., 1848, p. 35.

6. Or we may assume $\psi = (\cos x)^{2m}$; whence

$$\left(\frac{\psi'}{\psi}\right) = -2m \sec^2 x, \quad r = \frac{1}{m}, \quad k = -2m, \text{ and } \theta - \phi = c_1 + c \tan x.$$

In this case the general formula (3) becomes

$$[(D+\phi)(D+\phi+c_1+c\tan x)-(n+1)(c+n)\sec^2 x]\,y = X.$$

By putting $\phi = c_2$, and $c = 0$, this is reduced to

$$\{(D+c_1)(D+c_2) - n(n+1)\sec^2 x\}\, y = X,$$

which is the equation solved by Dr. Hargreave at p. 52, in the Paper already referred to, and from a particular case of which he derives the solution of the equation of Laplace's functions.

Sir Robert Kane read a paper by the Rev. Professor Callan, on the results of a series of experiments on the decomposition of water by the iron galvanic battery, with the view of obtaining a brilliant lime light.

JANUARY 23RD, 1854.

THOMAS ROMNEY ROBINSON, D. D., PRESIDENT, in the Chair.

ON the recommendation of the Council it was Resolved, that the following By-Law be adopted:—

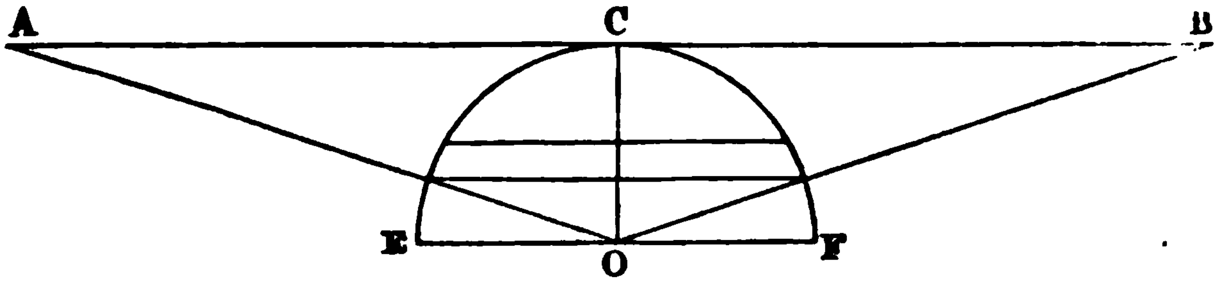
"That no Member whose subscription shall be due on the 30th November in each year shall have the privilege of voting on or after that date, until his subscription be paid up."

The President read the following Paper on a new method of measuring the angular aperture of the objectives of microscopes.

"Shortly after the commencement of those improvements which have made the microscope such a powerful instrument of research, it was observed that complete freedom from aberration and high magnifying power are not sufficient alone to give perfect vision to a certain class of objects; but that these essential qualities must be combined with a large angle of aperture. The scales of Lepidoptera and Thysanura, and still more the siliceous valves of certain Diatomaceæ, are well-known examples of this fact; and to the use of them as tests we mainly owe the astonishing progress which has lately been accomplished in this department of optical art. Several among us remember the admiration which was excited by the first objectives of 20° or 30° aperture, and which became still more enthusiastic when Ross carried this element to 60°, which was considered a *ne plus ultra*. But as objectives were improved, more difficult tests were found which stimulated progress, till angles of 170° and upwards have been obtained, by this great optician with us; by Nachet in France; and Spencer in America. The combination of science and operative skill which is

required to produce such miracles of art cannot be too much praised; and up to a certain point it must be confessed, that the performance of these objectives corresponds fully to their promise. It seems to me, however, that in the extreme cases to which I refer, there is not unfrequently some defect of construction which prevents them from being quite as effective as their great aperture might lead us to expect.

"The effect of *angular* aperture is merely an increase of illuminating power* analogous to that of *linear* aperture in a



telescope. Let O be a point of an object seen by an objective whose anterior surface is AB. This point, in the case of a test object, may be considered as self-luminous and equally so in every direction. Therefore, the light which it sends to the objective is measured by the portion of the hemisphere ECF, which is included by the cone AOB. If all that light came to the eye, the illumination would be measured by $4\pi \sin^2 \frac{\theta}{2}$, θ being = AOC; but this is never the case. The object is almost invariably covered with a piece of thin glass, both whose surfaces reflect a portion of the light if it be mounted dry, one only if it be in balsam.† A

* It does not depend on greater convergence of the rays; when the disked stop, hereafter described, was placed in a quarter 105° aperture, the ring of the objective left free showed a test object just as the same illuminating power of an ordinary one would do.

† For objects in balsam no light can escape at a greater incidence than 46°; therefore, notwithstanding the absence of the first reflexion, they will be less illuminated than in the other way. It is in fact equivalent to reducing the aperture of the objective below 100°, as far as illumination is concerned, though a much larger one may be required to take in the pencil; and it should not be used when it is desired to see details of the utmost minuteness.

similar loss occurs by the reflexion at the first surface of the objective, which, like the cover, is plane; and at all the others which are uncemented. To compute these last would require a plan of the objective's construction; but as I only wish to give an approximate estimate of the effect of aperture, and as the incidences there, and consequently the reflexions are comparatively small, it is sufficient to consider the loss of light at the first surface and at the cover alone. Further, as the first lens is *dense* flint glass, and the cover of the ordinary sort, the loss by the two reflexions may be assumed as equal to that caused by the single one of the lens. Taking for the dense flint, $\mu = 1{\cdot}67$, we can compute, by the help of a well-known formula of Fresnel, I the intensity of light transmitted at the incidence θ: the element of the hemisphere which transmits this light $= 2\pi . \sin\theta . d\theta$; and therefore, the quantity of light transmitted by the first surface is—

For an uncovered object, ... $2\pi\int I \sin\theta d\theta$.

For a covered, ... $2\pi\int I^2 \sin\theta d\theta$.

As yet, however, I have never seen an objective which, when compensated for uncovered objects, has a very large angle; and in some of them the difference is very great. No. 4, when set to the mark "uncovered" (which, I presume, was correctly placed by its maker), gave only 70°. From the short working distance which is inseparable from a large aperture, it is not a desirable mode of using them, as there is a great chance of the lens being sullied.*

"The following Table gives a few values of these angles, omitting the factor π.

* This reasoning assumes that the light transmitted through the cover is not less reflexible that it was before transmission.

Aperture.	$l = 1$.	Uncovered.	Covered.	First Surface curved $\theta' = 75°$.
20°	1·74	1·62	1·53	1·52
40°	6·91	6·47	6·07	6·06
60°	15·35	14·37	13·47	13·46
80°	26·81	25·07	23·45	23·46
100°	40·93	38·12	35·52	35·60
120°	57·30	52·90	48·86	49·21
130°	66·16	60·38	55·33	56·14
140°	75·40	67·93	61·89	63.05
145°	80·13	71.25	64·70	66·39
150°	84·93	75·23	67·26	69·69
155°	89·79	78·09	69·70	72·83
160°	94·69	81·68	71·54	75·89
165°	99·63	84·77	73·11	78·73
170°	104·60	86·56	73·97	81·52
175°	109·59	88·43	74·33	84·17
180°	114·59	88·60	74·52	86·84

"These numbers (which, from neglecting the remaining reflexions, must give rather too much weight to the larger apertures) show clearly that, especially for covered objects, nothing is gained above 150° at all commensurate to the difficulty of constructing such objectives. But in addition to this, I wish to call attention to the fact, that the whole of these great apertures is not in every case thoroughly effective.

"The mode of measuring them which is commonly used is that given by Mr. Lister, in which the microscope is attached to the alidad of a circular instrument, with its objective over the centre, and directed towards a luminary at some distance. Looking into it, the field is filled with light, which, on turning the alidad, is seen to have a circular boundary: if this be brought from each side to the middle of the field, the intercepted arc is the aperture.* For objectives of considerable

* When the aperture is very large, there is a sluggishness in the apparent movement of the boundary, which makes me have some doubt of the accuracy of the process; it seems almost stationary in No. 6.

focal length, this process is unexceptionable; but does not succeed so well with those of high power and aperture; the boundary is very faint, and sometimes difficult to observe. This is especially the case if the light be not uniformly diffused, or if the boundary be irregular; and if there be any false light, it is impossible to distinguish it from that which really contributes to vision.

"This was strikingly the case with an objective which lately came under my examination; it was a sixteenth, said by its maker to be 160°, and in which light actually was visible to that extent, though not satisfactorily. When, however, it was tried on the Pleurosigma Fasciola, it could not (even with the most oblique illumination that Amici's prism can give) be made to show this test better than a twelfth from the same artist, whose aperture is only 129°. This unexpected result made me seek some mode of measurement which would not only give the angle of aperture, but also show how the light was distributed; and the following seems to fulfil both these requirements.

"As a lucid point in the focus of the objective sends out from the eye-piece rays nearly parallel, so light sent in the opposite direction through the microscope will converge at that focus, and then diverge in a cone whose angle equals the aperture of the objective. If this cone be intercepted at right angles to its axis by a screen, and the diameter of its section, together with the distance of the screen from the surface of the objective, be carefully measured, they give the aperture. If S be the diameter of the section, D the distance, O the diameter of the objective, and I that of the image of the luminary used which is formed in its focus:

$$2 \tan \frac{A}{2} = \frac{S + O}{D} \times \frac{O}{O \mp I},$$

the upper sign being used if the section is measured within the penumbra, and *vice versâ*. In my practice I was so small

that the second factor is = unity, for I directed the light of the sun into the instrument by means of the reflecting part of a solar microscope, and not only got measures with extreme facility, but had at once a beautiful map of the objective's light-territory.

"No. 1. As a term of comparison I began with a quarter of known excellence. The section was a neat circle nearly uniformly bright, surrounded by a penumbra also equally well-defined. The measures were taken to 0·005, and they gave (denoting their results by A', and those of the ordinary process by A),

$$A' = 80°, 8, \quad . \quad . \quad . \quad . \quad A = 80°, 75,*$$

which for such determination may be reckoned identical.

"No. 2. The sixteenth just mentioned presented a very different appearance. The central part of the section was bright, with a jagged outline formed by dark bands spreading outwards in the direction of radii very far; so far indeed, that I could not trace their end, or see any boundary of the section. Between these bands were stripes of light, but so mottled and confused as to satisfy me that this part of the illumination could not give distinct vision. Looking directly at the objective, light could be seen even at an obliquity of 85°. The bright part within the radial shadows was not exactly circular; but, taking an average diameter, I found for the part which seemed to me alone likely to give effective vision,

$$A' = 110°,8, \quad . \quad . \quad . \quad . \quad A = 160°.$$

"No 3. The twelfth, also referred to, is much better: the section was toothed all round like a wheel, but to no great extent, and a defined boundary was visible. The diameter of the bright part gave

$$A' = 109°, 3, \quad . \quad . \quad . \quad . \quad A = 129°, 0.$$

* The compensation of these lenses was adjusted by the Pleurosigma Angulata.

This explained the equal performance of these objectives, by showing that in fact the effective portions of their apertures were nearly the same.

"No. 4. A similar twelfth, but not quite so good, gave for the bright part, and for the limit of the radial stripes of light,

$$A' = 102°, 0 \ldots; \; A'' = 122°, 5, \quad . \quad . \quad A = 126°, 4.$$

"No. 5. A tenth, said to be of 156°, had the same jagged edge of shadows fading to darkness without any definite termination; the light stripes were fainter than usual.

$$A' = 114°, 6, \quad . \quad . \quad . \quad . \quad A = 156°, 0.$$

In the usual method light could be seen through 159°, but was unbroken only through 115°.

"No. 6. A twelfth, said to be 170°, and in which light was seen through 169°, but for much of that arc so streaky, that I was prepared to find its performance not quite conformable to its aperture, though its workmanship is of the highest order. It presented in the solar apparatus the same appearance as No. 2, with this exception, that the bright central part was not uniform, two-thirds of it being brighter than the rest, and the change rather abrupt; three or four of the radial shadows were also much broader and blacker than the rest. For the clear diameter,

$$A' = 122°, 8, \quad . \quad . \quad . \quad . \quad A = 170°, 0.$$

On looking at this objective, light (and pretty bright too) could be seen even at 90°; which induced me to establish a second microscope, power 41, and fitted with a shade-glass, to examine the image of the sun which was formed in the focus of the objective. This image, whose diameter was 0·0007, was seen through a considerable range as a well-defined circle; but at last a bright curve, probably the edge of one of the cells, was seen to approach it ○) When it came into contact with this it became deformed, and increasing the

angle, it was drawn out into a brilliant line accompanied by several other images, which caused much confusion, but it was quite visible as far as 170°. All, I think, after it touched the image of the cell, were useless.*

"This objective was tried on that most difficult test, the Grammatophora Subtilissima, which it *did* show, but not nearly so well as a sixth of 132°, whose whole aperture was found to be quite perfect: the image which it gave was of a shadowy character, contrasting very unfavourably with the sharp definition of its companion; a result quite obvious if it be considered that the good part of its aperture is only 123°, and that the effect of all the rest must be actually injurious. This was verified by introducing behind the objective a stop

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* This mode of examining the aperture may, in many instances, be useful to opticians, as it can be performed with a camphine lamp. If the examining microscope be fixed on the alidad of the instrument, and that to be examined on a radial slide, light being transmitted through its eye-piece, and both be slided till their focal points be in the axis of rotation (which is ascertained by the image of the flame not moving when the alidad is shifted), it will be found that the image will continue sharp and distinct if the aperture be good, till:—1. It begins to decrease in brightness; 2. Its edge disappears; and 3. Lastly, it vanishes entirely.

Let R be the arc between the points where any of these facts are observed on each side, and a the aperture of ex. microscope's objective:

$$1.\ \ldots\ \tan \tfrac{1}{2} A = \tan \frac{(R+a)}{2} \times \frac{O}{O-I}.$$

$$2.\ \ldots\ldots\ = \tan \frac{(R-a)}{2} \times \frac{O}{O-I}.$$

$$3.\ \ldots\ldots\ = \tan \frac{(R-a)}{2} \times \frac{O}{O+I}.$$

The first of these is the least accurate.

If the objective have the defect just described, the image retains its brightness, but becomes deformed after a certain angle. In this way I estimated by the formula 2, the good part of No. 6 to be = 122°, 75, not far from the result given in the text. Four other objectives of large aperture gave by it measures according with those of Mr. Lister's method; though, among them also, one of 105 was indistinct for a few degrees.

of 0·125 diameter, which cuts off the irregular part. With this the Angulatum was seen in the most satisfactory manner; but when it was replaced by one carrying a central disc of 0·125, which stops out the good part, it would scarcely show even a trace of lines on the coarsest Pleurosigmata.

"These facts, I trust, are sufficient to show the necessity of attending not merely to the amount of aperture, but also to its quality. The objectives which I have examined are all of first-rate excellence in the good part of their apertures: I have not named their makers, nor the friends to whose kindness I am indebted for the power of examining so precious a collection, because it might lead some to unjust conclusions respecting the merits of the former. It is from no wish to depreciate the debt of gratitude which we owe them, or to undervalue the wonderful skill which they have shown in correcting aberrations so perfectly as they have done in these very objectives, that I make this communication, but from a wish to point out to *them* a defect which they will be able easily to remedy, and which at present occasionally interferes with their complete success. What its cause is can only be determined by one familiar with the construction of the objectives, but it probably arises from some of the lenses being so small that their edges meet the luminous pencil and reflect false light. I am induced to suspect this from observing that when in No. 6 the first lens was separated from the others by a revolution of the compensating screw beyond its proper adjustment (in which state, however, it would have no definition), the radial shadows disappear altogether, and $A' = 110°, 3$. Reducing the separation by a fourth of the revolution, they are seen, but of no great length, and enveloped in *a blue zone*, which surrounds the bright centre, the latter giving $A' = 139°, 9$. This increase of distance has the effect of stopping out the margins of the other

lenses. The disturbance, however, may also be owing to the brass of the cells, but if so the remedy is the same, namely, increasing a little the diameter of the posterior lenses. It is true that this involves an increase of their thickness, and of course a considerable change in the combination. I would also suggest another alteration, in case it be thought desirable still to make objectives of these extreme apertures; that the anterior surface be concave instead of plane. I do not suppose this would much increase the difficulty of the work of correction, and in fact No. 5 was so constructed. To show how much illumination would be gained by this, I have computed the fourth column of the Table, supposing the curvature such that the final incidence is 75°, and the object covered; from which it will be seen, that the difference at the limits is nearly the full power of an objective of 60° aperture, and that it almost compensates for the loss of light due to the cover."

The Rev. Dr. Todd read a Letter which he had received from William H. Harvey, M. D., written in Ceylon in November last, giving an account of his botanical and zoological collections. He also exhibited a restoration by Joseph H. Smith, LL.D., made from a rubbing of an ancient Irish inscribed grave-stone, with an inscription.

Dr. Petrie made some remarks upon the inscription.

The Rev. Dr. Todd presented a Walloon tobacco-box, with several Flemish inscriptions, from the Rev. William Thompson, said to have been found on the person of a soldier slain in the Battle of the Boyne.

Sir W. R. Hamilton having arrived after the period for reading papers, handed in a notice of his being ready to read his paper on the geometrical interpretation of biquaternions.

Dr. Petrie presented an ancient brass cauldron found at Sallow Glin, near Newtown, county of Kerry, from William Sandes, Esq., forwarded by Henry Stokes, Esq.

FEBRUARY 13TH, 1854.

HUMPHREY LLOYD, D.D., VICE-PRESIDENT, in the Chair.

HARLES DOMVILLE, ESQ., Rev. Robert Ferguson, LL.D., ıd J. R. O'Flanagan, Esq., were elected Members of the cademy.

D. H. Kelly, Esq., read a paper on an ancient terraced ravel hill, near Castle Blakeney, county of Galway:—

"This remarkable object is a gravel esker, near the vilge of Castle Blakeney, in the county of Galway, and is tuated close to the remains of the old Castle of Gallagh, ıe seat of a once-powerful family of the O'Kellys of Iy-Many, and which furnished several chiefs to that ancient oparchy.

"The present appearance of this esker is very remarkble, as may be seen by the rough sketch sent herewith.

"A length of 355 yards is cut off by two deep trenches at ach end from the centre of the gravel ridge, and the part hus isolated is carefully levelled on the summit and the sides, rtificially cut into terraces, like the mountain vineyards of he south of Europe, and the East.

"The summit is carefully levelled into a terrace, 36 feet ride; on its southern side are five other terraces, 16 feet ride each; and on the north are three terraces of the same ridth still existing, but there may have been originally more, s a large fence now skirts the hill on that side, whose contruction may have obliterated others.

"At the eastern end the terraced portion is cut off by a eep trench, or roadway, 20 feet wide, from an uneven mound, he remains of the *debris* of the ancient Castle of Gallagh, out f the ruins of which was constructed the mansion of Gallagh,

which, together with the surrounding property, became forfeited in 1641, and then passed from the O'Kellies of Gallagh, now worthily represented by Connor J. O'Kelly, late of Tycooly, but who now resides on a purchased estate, to which he has given the name of Gallagh, after the home of his ancestors; it then passed to the Blakeneys, of Abbert, now represented by J. H. Blakeney, Esq., a family always distinguished in the military service of their country, and of which the gallant defender of Minorca, in the days of George II., and in our own day, Sir Edward Blakeney, K.C.B., Commander of the Forces in Ireland, have been the most illustrious ornaments.

"Of this rebuilt pile, but one solitary chimney now remains to tell of its former splendour, but the present occupant of the farm assures me, that, when he got possession of it some twenty years ago, sixteen such chimneys were then standing, and a pile of building that gave evidence of very considerable extent.

"To the western end of the terraces the gravel esker appears to have been left completely in a state of nature, nor do I believe that it ever has been disturbed by any agricultural process.

"In the Annals of Clonmacnois, A.D. 1351, it is stated—'William mac Donogh Moyneagh O'Kelly invited all the Irish poets, brehons, bards, harpers, gamesters, or common kearrachs, jesters, and others of their kind in Ireland, to his house upon Christmas, this year, where every one of them was well used during Christmas holydays. And he satisfied each of them with presents at their departure, so as that every one of them was well pleased, and extolled William for his bounty, one of which assembly made certain Irish verses in commendation of William and his house, which began thus:—

Filiḋ Eireann go h'aon teaċ.'

"We are enabled to ascertain the author of this poem by one of Dean Lyons' tracings, now in the library of the Royal Irish Academy, and which was taken from a MS. in the College of St. Isidore, at Rome, from which it appears to have been the composition of Geoffrey Fionn O'Daly.

"This is the tracing—

Goffroiḋ Fionḋ o Dalaiġ cct
Filiḋ Eirein go h'aón teaċ.

"I am in possession of a very beautiful copy of this ancient poem, transcribed and literally translated for me by my valued friend, Eugene Curry, to whom Ireland is deeply indebted for rescuing most valuable portions of her history from oblivion and misrepresentation.

"But before comparing this remarkable vestige of the olden time with the description given in this ancient poem, it may be well to observe that William O'Kelly was the son of Donogh Muimneaċ O'Kelly, Chief of Hy-Maine, ob. 1307, by his wife, Duṁéara ni Conċoḃair (Duveassee O'Conor), daughter of the King of Connaught. He will be found No. 27 in the Tabular Genealogy of the O'Kellies, in 'The Tribes and Customs of Hy-Maine,' edited by my learned friend, Professor O'Donovan, for the Irish Archæological Society.

"This poem, after extolling William's liberality, and describing how, by means of his invitation, the other districts of Erin will that year be bereft of their bards, proceeds—

Biáiḋ aca aiṫne a ċeile	To each other will be known
Daṁa Foḋla fioñreiḋe	The professors of smooth-landed Fodhla;
Isḋaṁa Alban eaċtra ċian	And the far-travelled professor of Alba,
Ar dteaċta a n'arddbruġ Uilliam.	Coming to William's noble mansion.
Tiucfaḋ sin na seaċt ngráḋa	Here will come the seven orders
Do niḋ deilḃ an deaġ dana	Who form the shape of good poetry;

Sean dioġbala a dteaċt arteaċ	A charm for misfortune is their coming,
Na seaċt bpriom-ġraḋa fileaḋ.	The seven chief orders of the poets.

"A little further on he tells us what they were—

Béiḋ breaṫeaṁain breaṫ ndlíġiḋ	There will be the Brehons of legal judgment,
Béiḋ Draoite ⁊ deiġ-filiḋ	There the Druids and good poets;
Béiḋ na suirt úġdair Eireann	In his mansion will be the authors of Erin,
Luċt cúmḋaiġ na gcaiṫrei mean.	The chroniclers of triumphant histories.
Aer ċiúil Eireann anba an dream	The musicians of Erin in vast numbers,
Lucc gaċ ceirde go coitcean	The followers of every science in common,
An tuile dáṁ leat ar leat	The flood of professors from all quarters,
An ndál uile go haon teaċ.	Are all journeying to one house.

"He then, in a succeeding rann, describes the accommodation provided for them—

Atát loingṫiġe leabṫa	There are long houses of beds
Fa coṁair na cuideacta	On the smooth ridge of the dry eminence,
Ar ḋromċlaḋ nglan dtealaċdte	In preparation for the company,
Ar n'eagar ḋeáḋdaċ fite.	Well furnished with woven cloth.

"This exactly—'the smooth ridge of the dry eminence'—describes the terraced esker on which were erected wattle houses, covered with cloths like tents, and the poet then goes on to describe the respective streets, laid out for the accommodation of each class, and if we suppose a terrace allotted to each, we exactly coincide with the locality.

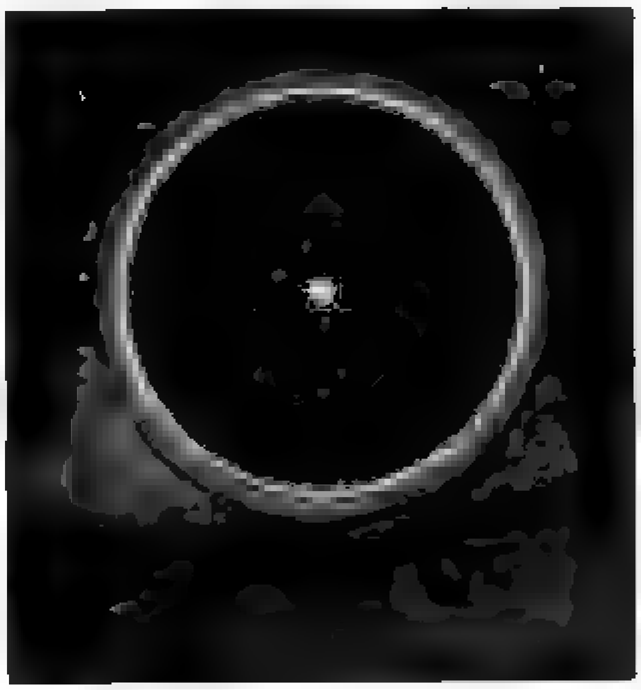
Atáid búiḋean trom dá ṫoiġ	A numerous company approaches the mansion;
Sráid brúiġean corr fá a gcóṁoir	A street of well-formed houses awaits them;
Na ngoire sin suairc an sgiaṁ	Near unto these, joyous its features,
Do hórdaiġeaḋ le hUilliam.	Has been ordered by William—
Sráid arleiṫ donluċt seanma	A separate street for the musicians
Dá mbeaḋ re a uċt irḟeaḋma	To be ready before him;
Seanċaiḋe Eireann aille.	The historians of beauteous Erin,
Is tiomsúġaḋ na trom-ḋáiṁe.	And the heavy throng of their associates.
Atáid san mbaile an ḃúiḋean	In the town is the multitude,
Cáiḋe sráid na Seanċaiḋeaḋ	Where is the street of the Shenachies;
Atá sráid ḟair sing oile	There is another extensive street,
Iona lfuilid fionn-toiġe.	In which are fair houses.
'Gon tsloġ fionn ar fial croiḋeaḋ	With free hearted hosts,
Ar ċionn ċliar ar ċlearaiġeaḋ	For receiving the histrionic troop,
Beag sin ag féaċaiḋ a bfuil	Trifling are these, seeing all that are
Tímċioll caṫraiġ ui Ċeallaiġ.	Around the Dun of O'Kelly.
Do sráidiḃ ar mo meaḋair	Of streets of greater merriment,
Ag slóġ aig-fir óirḃealaiġ	With generous hosts of manly aspect;
Aré dearsgaḋ ḟil orra	The manner of their situation is
Raoin ḟair sin ge eatorra.	With wide passages between them.
Mar atáid litre na líniḃ	As letters are placed in line,
Na sráid ċílte ṫaoiḃ ḃillid	So are those straight, intersected streets;
Gaċ sráiṫe slíġeaḋ luime	Every line of every street exact,
Réiḋe deirge dioġuinne.	Smooth, unobstructed, pleasant.

Do ṫiġiḃ bláiṫe cleaċ corr	Of houses graceful, handsome-ridged,
Dá sráiṫe ṫeaċ na timċioll	Each street by two ranges is lined,
Ar clár tilte do ṫoiġeaḃ	Thick set with houses is the level
Druim an aċaiḃ ḟionn-ċloisḋiḃ	Of the ridge of habitations, with its white enclosure.
Atá ar ċúl an ċláir tilte	At the end of the crowded level
Dún ina cair cinnlitre	Is a mansion like a capital letter;
Cinnlitir cloiċe aille	An illuminated capital, a beauteous castle;
Dún na ḟlaṫa ḟionn ġaille	The Dun of a fair-cheeked chief,
Daingean cloċ an dúnaiḃ ḃe	And the stronger is the Castle Dun by it,
Loċ ar cúlaiḃ na cloiċe.	A lake behind the Castle.
Realta cloiċe ar cian soḟear	A star of a Castle as such long acknowledged
Os linn loċa na n'Eígear	Over the waters of Lough na-n-Eigeas;
Giḋ áille an ċlaċ don taoḃ ṫall	However beauteous the Castle within,
A caom amaċ mar ṁeamram.	Its outer surface was like vellum.

"After carefully examining the locality, I feel no doubt on my own mind that this very remarkable vestige of the days of yore is the scene of the entertainment immortalized by O'Daly, and that the Castle of Gallagh, which then adjoined it, was the 'illuminated capital letter of a Dun' described by the poet as dominating over the straight lines of streets, as may be beheld in any of our old MSS., and a very apt simile it was for the relative positions of the locality. It is true the lake no longer forms part of the scene, but any one who takes his stand on the mound where once the Castle stood will perceive, just behind it, an extensive morass, which, before these days of drainage, may well have been Loch na-n-Eigeas."

Robert Mallet, Esq., read an account of a remarkable lunar halo on the night between the 10th and 11th instant:—

"At 12 o'clock, night, between the 10th and 11th February, 1854, looking from a southern window of my house (Delville, Glasnevin), I observed the nearly round disc of the moon, then thirteen days old, riding high in an almost clear heaven, and surrounded by a very large and perfectly circular halo. The size of the circle was such as to convey an idea of great grandeur, almost of awe, and the great comparative diminution of the apparent magnitude of the moon's disc within it, which really seemed as though it could be covered by a shilling, was equally striking.



"The annexed diagram is intended to represent the general appearance of the halo.

"I had no means of directly measuring the angle subtended by the inner edge of the ring, which, however, was so large as to be with difficulty kept within the field of vision with the eye fixed.

"The inner edge of the halo was well defined, and slightly tinted with prismatic red, passing outwards into orange and yellow, and the whole becoming evanescent into white vapoury mist or light cloud. The prevailing colour of the mass of the ring was that of white bright moon-illuminated cloud. The width of the distinguishable annulus (which was almost uniform all round) was from one-eighth to one-seventh of the internal diameter. Towards the lower part, the shading off into vapour assumed a streaky appearance, like scirrus cloud, and below the ring were larger surfaces of very light fleecy scirrus and cumulo stratus,

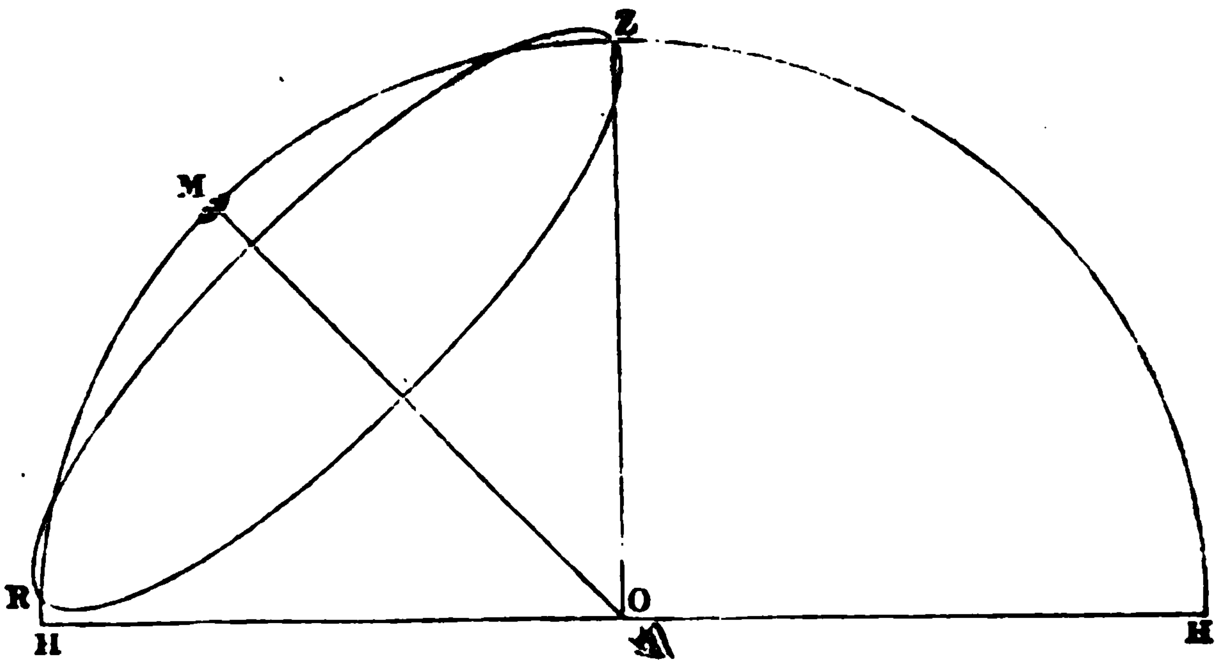
clouds. One star of the third magnitude was clearly visible in the deep blue-gray surface inside the ring, which was free from any trace of vapour or cloud,—the other stars were lost in the moon's light. There was neither corona nor paraselene.

"The night was cold and frosty, the air dry and crisp, and pleasant to the feelings at the surface of the earth. The day had been remarkable fine and clear; the preceding night a clear one, with hard frost.

"There was little or no wind stirring at 12 o'clock, night, 10th–11th February. The barometer had been high for several days, and at 8 o'clock A. M. on the morning of the 11th February was 30·52 inches; thermometer on a northern exposure, 35° Fahr.

"The front of the house whence I looked is due south, the face ranging therefore E. and W. Looking out of window, and directly upwards with my eye as nearly as possible plumb under the edge of the stone cornice about twelve feet above me, I perceived that the interior of the upper limb of the ring almost exactly reached the zenith, and formed a tangent to the line of cornice.

"The moon's place being known, therefore, it is easy to find the apparent diameter of the ring.



Thus let HH be the horizon; O the place of the observer; Z the zenith; M, moon's place; ZR, apparent diameter of the halo.

"For the position of the moon I am indebted to our President, Dr. Robinson.

"The place of observation may be taken as—

Latitude, 53° 22′ 29″
Longitude, 0^h 25^m 12^s

Then at 12, night, of 10th–11th February, 1854,—

Zenith distance of moon's centre	=	42°	38′	29″
Parallax,	+		37′	1″
Refraction,	−			57″
Apparent zenith distance of moon's centre, ...		43°	14′	33″
Semi-diameter,	±		14′	45″

This would give the apparent internal diameter of the ring about 86½ degrees, which would bring that of the densest and most highly illuminated part, at or near the yellow light, to about 90 degrees.

"This halo *may*, therefore (as suggested by Dr. Robinson), have been one of those formed by two refractions. The absence of any inner ring, however, throws some doubt upon this.

"The determination of the precise angles subtended by these halos is of interest. Dr. Young having shown that they depend upon refraction and reflexion from minute crystals of suspended ice, and Arago's experiment having proved that the light which passes has been polarized by refraction, it follows that the angle of the primary form of ice being assumed = 60° or 30°—measurements of this character afford the means of obtaining the possible *secondary crystalline forms* of ice crystals suspended in the higher regions of the atmosphere, and there produced under conditions likely to extend our knowledge, as yet so very limited, of some of the forces upon which secondary crystalline forms depend for their production.

"It may be remarked, that Mr. Howard has recorded his observation that halos of this sort occurring in spring are usually succeeded by very hot weather."

Mr. Mallet also read a paper containing notices of the facts of the British earthquake of 9th November, 1852.

On the part of Mrs. Lambert, of Lough Scur, Cashcarrigan, Rev. Dr. Todd presented a stone mould for casting bronze celts. He also presented, from William Wakeman, Esq., a rubbing from an inscribed stone in the island of Inis no Coill, in Lough Corrib, shown by Dr. Petrie to be the gravestone of Lugnat, son of Liemania, sister of St. Patrick.

February 27th, 1854.

THOMAS ROMNEY ROBINSON, D.D., President, in the Chair.

The Secretary read a paper, by George James Knox, Esq., on the transmutation of metals.

Mr. Thomas Grubb read the following account of a new method of determining, approximately, the spherical aberration of a combination of lenses for microscopic purposes:—

"The methods hitherto at our option for investigating the spherical aberrations of a system of lenses, having spherical surfaces, are—firstly, the purely mathematical, involving (where the thickness of the lenses is required to be included, and more especially where the angle of aperture is considerable) such intricacy in the calculations as renders the process nearly useless to practical persons; and, secondly, the more practical method of constructing diagrams of large size, in which two or more rays, at different distances from the axis of the compound, are geometrically traced, according to the laws of optics.

"Much of my leisure time has, for several years, been devoted to inquiries including, necessarily, the construction of such diagrams; and I cannot speak too highly of their value in giving to the experimenter in optics a thorough practical insight into the effects of the various forms and combinations which will be suggested, more especially when the improvement of the compound objective of the microscope is under consideration.

"It may be desirable here to state, that these diagrams were usually drawn on a scale ten times that intended for use, the radii of the arcs, from which the sines were measured

(and which were constant for all the surfaces of a combination), were usually three and sometimes six inches ; the arcs were struck and the sines measured at both sides of the centre (to avoid errors of eccentricity), and the measurement of the sines taken with a scale of fiftieths of an inch, using a magnifier, and estimating to tenths of divisions, or say 1-500th of an inch.

"By tracing—with these precautions, and with care—two rays, one passing through nearly the margin of the combination, and the other at one-half that distance from the axis, an approximation to the state of the spherical aberration of the compound, adequate for such combinations as are used in the construction of the objective of the microscope, may be obtained.

"Some practice in delicate manipulation is, however, required to arrive at the precision indicated, and even for approximate investigations a more accurate method would be desirable.

"When, however, combinations of small aperture, compared with their foci (for example, such proportions of these as are adapted to the object glass of the telescope), are under examination, the method of diagram fails entirely in the accuracy requisite to estimate the correction of the spherical aberration.

"Such difficulties in the way of practical research induced me to consider how far the objections, arising out of the intricacy of the one mode of investigation, and the inadequacy of the other, might be obviated by adopting a *mixed* method of proceeding. In short, it appeared that the diagrams not only included those conditions arising out of the thickness of the lenses, but that they would serve to furnish with sufficient accuracy for all cases that point in each surface where the ray impinges, and also the angle of its incidence. Little more thus remained to be done than to find a simple expression for the aberration of each surface for the ray, and this,

after some trials, I obtained in a very convenient form, as follows:—

"*D* being the deviation of the ray (not from one lens into another, but always) either from air into a lens, or from a lens into air, *a* is as ($\sin^2 D$). Then, calling the aberration of the entire combination *A*, and a_1, a_2, a_3, &c., the aberrations (calculated from the above formula) at the 1st, 2nd, 3rd, &c., surfaces of the compound, *A* is equal to the sum of a_1, a_2, a_3, &c. (respect being paid to their signs), these being plus when the ray is deflected towards the axis, and minus when the contrary.

"When the spherical aberration of the compound under examination is corrected, the sums of the + and − aberrations will be equal, and *A* will evidently be zero, while in any other case, the + and − quantities will exhibit a fraction showing their relative proportion, and will indicate to the practical operator the means of a closer approximation to perfect correction.

"The entire process may be shortly described as follows:—

"A diagram of the combination to be examined being made with care, and of a size as large as circumstances permit,—one single ray must be traced (in the usual manner) through the diagram; the most suitable distance for this ray from the axis of the combination will depend upon the angular aperture. For combinations of small angular aperture I prefer 3-4ths to 4-5ths of the semi-aperture for this distance. In addition to this (should the combination have any two surfaces in contact), the direction of the ray from these *into air* must be projected.

"The diagram is now fitted for obtaining the sine of *D* for each surface; these, being measured on a scale of equal parts, and tabulated, and afterwards squared, give a_1, a_2, a_3, &c., which being separated, as directed, into + and −, give, in their sums, two quantities, representing respectively the positive and negative aberration of the whole combination.

"Having examined diagrams made some time ago, and the calculations connected with same, with a view to ascertain the limits of error of this process, it appears that, allowing an error equal to 2-10ths of a division of the scale used in estimating the sines, the probable limits of error are only 1-50th part of the numerical sum of the aberrations, a quantity which may be considered insensible in practice, and probably not one-half of that error, or departure from the true spherical figure of a surface, which takes place (and with contrary signs) during the polishing, according as the lens, or polisher, is upper during the process."

Rev. Dr. Graves read a note from Sir W. R. Hamilton, in which he stated that he had lately arrived at a variety of results respecting the integrations of certain equations, which might not be unworthy of the acceptance of the Academy, and the investigation of which had been suggested to him by Mr. Carmichael's printed Paper, and by a manuscript which he had lent Sir W. Hamilton, who writes,—"In our conclusions we do not quite agree, but I am happy to acknowledge my obligations to his writings for the suggestions above alluded to, as I shall hereafter more fully express.

"So long ago as 1846, I communicated to the Royal Irish Academy a transformation which may be written thus (see the Proceedings for the July of that year):

$$D_x^2 + D_y^2 + D_z^2 = -(iD_x + jD_y + kD_z)^2; \qquad (1)$$

and which was obviously connected with the celebrated equation of Laplace.

"But it had quite escaped my notice that the principles of quaternions allow also this other transformation, which Mr. Carmichael was the first to point out:

$$D_z^2 + D_x^2 + D_y^2 = (D_z - iD_x - jD_y)(D_z + iD_x + jD_y). \qquad (2)$$

And therefore I had, of course, not seen, what Mr. Carmichael has since shown, that the integration of Laplace's equation of

the *second* order may be made to depend on the integrations of *two linear* and conjugate equations, of which one is

$$(D_z - iD_x - jD_y) V = 0. \tag{3}$$

"I am disposed, for the sake of reference, to call this '*Carmichael's Equation;*' and have had the pleasure of recently finding its integral, under a form, or rather forms, so general as to extend even to *bi*quaternions.

"One of those forms is the following:*

$$V_{xyz} = e^{z(iD_x + jD_y)} V_{xy0}. \tag{4}$$

"Another is

$$V_{xyz} = (D_z + iD_x + jD_y) \int_0^z \cos\{z(D_x^2 + D_y^2)^{\frac{1}{2}}\} V_{xy0} dz; \tag{5}$$

where V_{xy0} is generally an *initial biquaternion*; and where the *single* definite integral admits of being usefully put under the form of a *double definite integral*, exactly analogous to, and (when we proceed to Laplace's equation) reproducing, a well known expression of Poisson's, to which Mr. Carmichael has referred.

"These specimens may serve to show to the Academy that I have been aiming to collect materials for future communications to their Transactions."

The Secretary read a letter from Count de Mac Carthy, presenting several books printed at Toulon.

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* "*Note, added during printing.*—Since writing the above, I have convinced myself that Mr. Carmichael had been in full possession of the exponential form of the integral, and probably also of my chief transformations thereof; although he seems to have chosen to put forward more prominently certain other forms, to which I have found objections, arising out of the non-commutative character of the symbols *ijk* as factors, and on which forms I believe that he does not now insist.—W. R. H."

MARCH 16TH, 1854. (Stated Meeting.)

THOMAS ROMNEY ROBINSON, D.D., PRESIDENT, in the Chair.

M. William Vrolik, of Amsterdam, was elected an Honorary Member in the Department of Science, and M. Alfred de Maury, of Paris, was elected an Honorary Member in the Department of Antiquities.

The Secretary of the Academy read the following Report from the Council:—

REPORT.

The history of the Academy during the past year has had but few events, which may be very briefly told.

The most important fact to be placed on record is the exhibition of our Museum in the Antiquarian Court of the Great Dublin Exhibition, in connexion with the Royal Dublin Society, in 1853.

The very remarkable collection of Irish Antiquities which was there brought together formed a most interesting and creditable feature of the Exhibition, and attracted a great deal of attention from the enlightened antiquarians of Great Britain and of the Continent, who visited Dublin during the past summer. It was also most attractive to the general public, and, next to the Picture Gallery, may be said to have been one of the most popular departments of the Exhibition. It is also very gratifying that no loss or injury was sustained by anything which the Academy exhibited; we have received the entire collection back without any diminution of its value.

The Council have to congratulate the Academy on the progress that has been made in the completion of the noble rooms that will now be opened for the reception of our Library and Museum.

The removal of the Museum into the Exhibition Building during the past summer has necessarily suspended the operations of the Committee appointed for the preparation of the Museum

Catalogue. But several very successful experiments have been made on the possibility of applying the newly discovered photographic processes to the object of the Pictorial Catalogue. The result of these experiments, which have been conducted by Dr. Graves and Mr. Tennison, has been laid before the Council, and has been so satisfactory, that a photographic apparatus has been purchased, and there is no doubt that we shall be able, at a very trifling cost, to produce pictures of our Antiquities, which we may communicate to all foreign and sister Societies, and which will be of the utmost value in disseminating, amongst antiquarians of other countries, a knowledge of the contents of the Museum.

Notwithstanding the disadvantages under which the Academy has laboured during the past year, from the unfinished state of our premises, and from the consequent inaccessibility of our Library and Museum, we have had many very valuable contributions to our Transactions and Proceedings, in all the departments to which our studies are devoted.

In Pure Mathematics, we have had papers from Dr. Graves, on his "Theory of Triplets," and on "The Solution of Linear Differential Equations;" and from Mr. Jellett on "The Properties of Inextensible Surfaces."

In the Mixed Mathematical Sciences, Dr. Lloyd has contributed to our memoirs papers on "The Influence of the Moon on the Movements of a freely suspended Magnetic Needle," and on "The Meteorology of Ireland, as deduced from the Observations made under the superintendence of the Committee of Science." Professor Allman, of Galway, has given us an account of the late ever-to-be-lamented Professor Mac Cullagh's "Lectures on Attractions and on Clairaut's Theorem;" and Mr Haughton has communicated some "Observations on the Application of Mr. Green's Formula to M. Jamin's Experiments on Reflected Polarized Light." The President has read a paper on "The Advantages which have recently been recognised in the Cassegranian Reflecting Telescope;" and in another paper has explained "An original and entirely new Method of measuring the effective apertures of the Objectives of Microscopes." Professor Callan, of Maynooth, has communicated to us the results of his experiments "On the Decomposition of Water by the Galvanic Battery, with the view to obtain a constant and brilliant Lime Light."

Dr. J. W. Mallet has contributed to our Transactions a paper giving "An Analysis of the Metals of which the Irish Antiquities found in our Museum are composed;" and Mr. Grubb has communicated "An Original Method of determining practically the Spherical Aberration of a Combination of Lenses." We have also had a paper from Mr. Knox on the "Transmutation of Metals."

In the Natural Sciences, we have had communications during the past year from Professor Allman, of Dublin, "On the Structure of Hydra," and "On the Structure of the Starch Granule;" and also from Dr. Lyons, "On the Primary Stage of Histogenesis and Histolysis." Mr. Mallet has also communicated an interesting paper "On the British Earthquake, November 9, 1852."

In the department of Polite Literature, we have had papers by Dr. Hincks on some additional discoveries made by him in the "Interpretation of the Assyrian Inscriptions;" by Dr. Drummond "On the Achievements of Magnus Barefoot, King of Norway, and his Defeat and Death in the Battle of Magh Cobha, A.D. 1103;" and by Dr. Orlando Dobbin, "On the Readings of the Codex Montfortianus, preserved in the Library of Trinity College, Dublin."

In Antiquities, Dr. Petrie has contributed to our Proceedings some valuable remarks on the inscriptions on the Cross of Tuam, exhibited at our Great Exhibition, which have completed and perfected what this distinguished antiquary has already published on the Tuam Cross, in his work on "The Round Towers of Ireland." Dr. Aquilla Smith has also communicated some additions to his papers on "Irish Tokens." Mr. Denis Henry Kelly has given us an interesting paper on "The Curious Terraced Gravel-Hill near Castle Blakeney, County Galway;" and the Secretary of the Academy has contributed some remarks on the singular Fresco Painting in the Abbey of Knockmoy, a fac-simile of which was exhibited in the Antiquarian Court of the Great Exhibition, and has since been presented to the Academy.

During the past year, the Academy's Museum has received several most important and valuable additions, by donation as well as by purchase. Amongst the donations, we have received from the Commissioners of Public Works, through Mr. Mulvany, a curious collection of antiquities found in the drainage of Lough Mask; and some valuable articles found in Lough Oughter and Lough Gowna,

and the neighbourhood, were presented by Mr. Mulvany; also some interesting antiquities by Mr. Manning and Mr. Lyons.

We have to thank the Marquess of Sligo for a large number of Terra Cotta Vases, which he has, in the most liberal manner, presented to our Museum, having offered to the Council their choice of all the vases in his collection.

It is incumbent upon the Council also to put on record, in this Report of the events of the past year, that Sir Richard O'Donnell has again intrusted to our care the beautiful and celebrated reliquary called the *Cathach*.

The antiquarian movement, which was made in connexion with the late Exhibition, and for which we are mainly indebted to Lord Talbot de Malahide and Dr. Lentaigne, has added greatly to our Museum. We have been promised casts of all the crosses exhibited, which attracted so much attention from our antiquarian visitors; and, in addition to this, Lord Talbot has procured us several casts of antiquities which were at the Exhibition, and which will now be preserved in our Museum as a permanent record of the great benefit which has resulted, even to Antiquarian Science, from that truly national undertaking.

Some important specimens of stones inscribed with the Ogham character have been presented to our Museum during the past year, by Mr. R. Hitchcock.

We have also to record, as one of the events of the year, a most valuable bequest of Books and Manuscripts, by our late zealous and active member, William Elliott Hudson, selected from his large Library, in accordance with his will, by four members of the Academy. This collection contains upwards of 800 works, a catalogue of which is preparing for publication. We have had the gratification of receiving as a gift from his executors a bust of our benefactor, by Moore, which will recall him to the recollection of his friends and acquaintances in the Academy.

The accurate model of Staigue Fort, which was exhibited at the Exhibition, has been presented to our Museum by James Bland, Esq., and our MS. Library has been enriched by some autograph volumes, in the handwriting of the celebrated Dean of St. Patrick's, Dr. Jonathan Swift, presented to us by G. C. Cowell, Esq.

It is the duty of the Council now to announce to you, that the

late Secretary of Council, the Rev. Charles Graves, has signified his intention of resigning the office which he has for several years past so efficiently filled. Those only who have been engaged with Dr. Graves, in the actual working of the Academy, can fully estimate the magnitude of the loss which his retirement will occasion.

During the past year, fifteen new members have been added to the Academy. Their names are as follows:—

Rev. William Fitzgerald, D. D.
Major John Bonner.
Rev. Beaver H. Blacker.
J. E. Butler, Esq.
F. R. Davies, Esq.
John Lentaigne, M. D.
James John Mac Carthy, Esq.
Alexander Read, M. D.
Henry H. Stuart, M. D.
Eugene Curry, Esq.
John Thomas Rosborough Colclough, Esq.
James Butler Pratt, Esq.
Charles Domville, Esq.
Jas. Roderick O'Flanagan, Esq.
Rev. Robert Ferguson, LL. D.

During the same period two Honorary Members, and five ordinary Members, have been lost to us by death. The following is a list of their names, with the dates of their deaths, as far as it has been possible to ascertain them :—

HONORARY MEMBERS.

1. FRANÇOIS JEAN DOMINIQUE ARAGO; elected 30th Nov. 1844: died 2nd October, 1853. (Science.)

2. G. T. GROTEFEND; elected 30th Nov. 1850. (Antiquities.)

ORDINARY MEMBERS.

1. SIR WILLIAM BETHAM; elected 22nd January, 1827; died 26th October, 1853.

2. SIR MONTAGUE L. CHAPMAN, Bart.; elected 11th December, 1843. (Date of death not known.)

3. JOHN GRENE, Esq.; elected 10th January, 1848: died 30th April, 1853.

4. WILLIAM ELLIOT HUDSON, Esq.; elected 12th April 1841: died 23rd June, 1853.

5. SIR FRANCIS WASKET-MYERS; elected 13th January, 1851. Date of death not known.

Of the two Honorary Members whose names occur in the foregoing list, one has occasioned a vacancy in the class of Science, and

one in the class of Antiquities. The Council have recommended to you, to be balloted for at this meeting, M. Vrolik, of Amsterdam, one of the most eminent naturalists of the present day, to be elected an Honorary Member in the class of Science; and M. Alfred de Maury, President of the Société des Antiquaires de France, to be elected an Honorary Member in the class of Antiquities.

It was resolved,—That the Report of the Council be adopted, and printed in the Proceedings.

The Ballot for the annual election having closed, the Scrutineers reported that the following gentlemen were elected Officers and Council for the ensuing year:—

President.—Rev. Thomas R. Robinson, D.D.
Treasurer.—Robert Ball, LL.D.
Secretary to the Academy.—Rev. J. H. Todd, D.D.
Secretary to the Council.—Rev. John H. Jellett, A.M.
Secretary of Foreign Correspondence. — Rev. Samuel Butcher, D.D.
Librarian.—Rev. William H. Drummond, D.D.
Clerk and Assistant Librarian.—Edward Clibborn.

Committee of Science.

Sir William R. Hamilton, LL. D.; Rev. Humphrey Lloyd, D. D.; James Apjohn, M. D.; Robert Ball, LL. D.; Sir Robert Kane, M. D.; George J. Allman, M. D.; Rev. Samuel Haughton, A. M.

Committee of Polite Literature.

Rev. William H. Drummond, D. D.; Rev. Charles W. Wall, D.D.; John Anster, LL. D.; Rev. Charles Graves, D.D.; Rev. Samuel Butcher, D.D.; Digby P. Starkey, Esq.; Rev. John H. Jellett, A. M.

Committee of Antiquities.

George Petrie, LL. D.; Rev. James H. Todd, D. D.; J. Huband Smith, Esq., LL. D.; Aquilla Smith, M. D.; Earl of Dunraven; Thomas A. Larcom, Colonel, R. E.; Lord Talbot de Malahide.

It was moved by F. J. Sidney, LL. D., and seconded by Rev. Joseph Galbraith:—

"That the Academy recommend to the Council—

"1. That three Members of the Council should retire in rotation each year—one from each Committee.

"2. That the By-Law which requires the election of three distinct Committees be repealed, and that a general Council of twenty-one be annually elected, pursuant to charter."

The Rev. Charles Graves, D. D., moved the following amendment, which was seconded by Rev. Humphrey Lloyd, D. D.:—

"That the Council be recommended to take into its consideration the By-Laws relating to the constitution and election of the Council,—especially in reference to a greater amount of annual change among its Members."

A division having been called for, it appeared that twenty had voted for the amendment, and nineteen against it. The President, therefore, announced that the amendment was carried.

The President nominated, under his hand and seal, the following Vice-Presidents:—

Rev. Humphrey Lloyd, D. D.; Lt.-Colonel Larcom, R. E.; George Petrie, LL. D.; Rev. Charles Graves, D. D.

MONDAY, APRIL 10TH, 1854.

HUMPHREY LLOYD, D.D., VICE-PRESIDENT, in the Chair.

CHEYNE BRADY, Esq., and Sir Bernard Burke, were elected Members, and, on the recommendation of the Council, the name of William R. Wilde, Esq., was replaced on the list of Members of the Academy.

On the recommendation of the Council it was Resolved:—

"That Chapter IX. of the By-Laws be repealed, and that, in future, the Committee of Publication shall consist of the Council at large, with liberty to call up any Member or Members of the Academy to assist them, *pro hac vice*, in judging of the papers before them."

Rev. Charles Graves, on the part of The Mac Gillicuddy of the Reeks, presented four Ogham monuments, recently exhibited in the Archæological Court of the Great Exhibition of 1853; he also communicated an account of the inscriptions on these stones, and the circumstances of their discovery.

Rev. Charles Graves exhibited a number of photographic pictures of objects in the Museum of the Academy, executed by Edward K. Tenison, Esq., for the purpose of proving the applicability of the photographic process to the purposes of a pictorial or illustrated catalogue.

Monday, April 24th, 1854.

THOMAS ROMNEY ROBINSON, D.D., President, in the Chair.

Rev. Samuel Haughton gave an account of the laws of the diurnal tide at Donaghadee, county Down, and at Bunowen, county of Galway, as ascertained from the observations made under the superintendence of the Committee of Science in 1851.

Dr. Allman read an extract of a letter from Dr. W. H. Harvey, communicating some anomalous facts respecting the tides at King George's Sound, Australia.

The Secretary read a letter from Dr. Edward Hincks, in which he states:—"In my communication, printed in the Proceedings of March 16, 1853, I mentioned three subdivisions of the manah. I have lately discovered a still smaller one, equivalent to about 4·3 grains. It was the thirtieth part of the shekel, or 1-1800th of the manah. The monogram which represented it was , and I propose to call it a gerah. The Assyrian name of none of these subdivisions of the manah has yet been discovered. It seems to me probable that the Assyrians kept their accounts in manahs, and in what I call shekels and gerahs —the sixtieth and eighteen hundredth parts of the manah. I infer this from a sort of memorandum which I met with on a terra cotta tablet in the British Museum. It is to this effect—

1 shekel, ...	6 gerahs.
10 shekels, ...	2 shekels.
1 manah, ...	12 shekels.

It is evident, from the remainder of the lines being identical, that the same ratio exists between the two weights in each line; and this appears, from the second line, to be the ratio of five to one. It follows that the weights in the second line are ten times those in the first; and those in the third are six times those in the second. This requires that the manah should *be equal to* sixty shekels, and the shekel to thirty gerahs."

May 8th, 1854.

LIEUT.-COL. LARCOM, F.R.S., Vice-President, in the Chair.

Parke Neville, Esq., was elected a Member of the Academy.

Rev. Dr. Todd read the following Paper, by the Rev. J. G. Cumming, on the inscribed stones in the Isle of Man, of which casts have been purchased for the Museum:—

"The Danes and Norwegians occupied the Isle of Man from the beginning of the tenth to the latter part of the thirteenth century.

"Some of the most interesting memorials which they have left behind them are about thirty different Runic monuments, the best of which are included in the present series, of which the dates range from the beginning of the eleventh to the end of the twelfth century. From the close connexion at that time existing between the Scandinavians in Ireland and those in Man, we may naturally expect to meet with some general resemblance between the Manx and Irish crosses. Yet the Manx Runic cross-makers appear to have largely exercised their own fertile genius in the delineation of those now under consideration. This is to be noticed more particularly in the conversion of the cable-work, or Runic knot, as it has been called, into interlacing figures of dragons, or some monstrous scale-covered animals. There is also some resemblance between the Manx crosses and those found in the Scottish Lowlands, and Eastern Scottish Highlands.

"The crosses and tombstones in Iona are most likely later than these, and may in part have been borrowed from them. Considering the very close connexion between Iona and Man, they forming parts of the same bishopric, from A. D. 1100 to

A.D. 1380, and being nearly the whole time under the same or closely connected sovereigns, and several kings of Man (Scandinavians) being buried at Iona, it does appear singular that there should not be a single cross, with a Scandinavian Runic inscription, in this latter island. But neither in England nor Scotland are found Runic stones with Scandinavian inscriptions, so that these Manx crosses appear unique for Great Britain. The inscriptions on the Manx crosses are all in Runic characters, and in the ancient Scandinavian or Icelandic language. There is a peculiarity, however, in the Manx runes. The symbol which in ordinary Runic writings stands for 'o' in the Manx represents 'b,' and the Manx have a symbol of their own for 'o.' The Manx have no symbol for 'h' or 'y.' It is interesting to note that this fact holds good even in the inscription on cross No. 4, where, excepting in the instances of 'b' and 'o,' the runes agree with the ordinary Runic writings, and differ from the *older* Manx. We may, perhaps, get a key to this variation by observing that all the names in the inscription on No. 4 are *Gælic*, and not, as on the other stones, *Scandinavian*.

"No. 1.—This cross stands in the centre of the churchyard of Braddan. It is the most elegant and highly finished of any in the island, but has been broken in the middle and otherwise defaced. Its age is probably the end of the twelfth or beginning of the thirteenth century. The ordinary cable-work is here converted into interlacing dragons, or monstrous scale-covered animals. It is sculptured on three sides, the fourth side being occupied by the following Runic inscription, somewhat imperfect in the middle:—'Thurlabr Neaki risti krus thana aft Fiak sun in bruthur sun Jabrs,' i. e. Thorlaf Neaki erected this cross to Fiak, the son of his brother, a son of Jabr.

"No. 2.—This cross stands near the south porch of Braddan church. It is probably of a later date than the last, and in the same style as that at Onchan, No. 11. The monstrous

animals are not unlike some seen on monuments in Iona. It has no Runic inscription.

"No. 3.—This cross, the largest but one on the island, stands in front of the church gate of Kirk Michael. The rich carving presents to us figures of stags, dogs, horses, horsemen, and at the base we have the peculiar scale-covered animals, which have been more fully developed in No. 1.

"The inscription on one side reads from the bottom upwards, as is generally the case:—'Jualfr sunr Thurulfs eins Rautha risti Krus thana aft Frithu muthur sino,' i. e. Joalf, son of Thorolf the Red, erected this cross to his mother, Frida.

"No. 4.—This cross stands on the north side of the gate of Kirk Michael. It is of a later date than the former ones. The inscription, which is on the back, is rather doubtful, but seems to be:—'[raisti krus] thana aft Mal Muru fustra sin M'Tader Dufgals kona is athisi ati.' It is interesting from its containing Gaelic names. It is also written with runes more approximate to the Anglo-Saxon runes than are the other Manx inscriptions, but retaining the Manx variation in the runes for 'b' and 'o.'

"No. 5.—This cross stands on the wall on the south side of the church gate at Kirk Michael, and appears to be earlier than any of the previous crosses, and contains the name of the maker 'Gaut,' or, as he calls himself, 'Gautr Bjornson,' on the large Andreas cross, and here states that he made this and all which were then in Man. It is also remarkable as giving the manner in which the name of the island was pronounced by the Norwegians, 'Maun;' it also contains the ubiquitous name of Smith. The inscription is—'Mail Brigdi sunr Athakans smith raisti krus thana fur salu sini sin brukuin Gaut girthi thana auk ala i Maun,' i.e., Malbrigid, son of Athakan (the) smith, erected this cross for his soul. . . . . . Gaut made this (cross) and all on Mann.

"No. 6.—This elegant cross stands to the north of Bishop

Wilson's tomb, at Kirk Michael. It is carved on both sides, but has been much injured, and contains no Runic inscription.

"No. 7.—This fragment of a fine cross is also at Kirk Michael, built into the top of the church wall. The inscription, which was written on the back, near one side, has been broken by the masons, to make it fit in the bend of the wall. The only words remaining are, 'krus thana aftir,' this cross to . . . .

"No. 8.—This is the fragment of a beautifully carved cross, containing only the inscription—'Grims eins Suarta,' i. e. 'Grims the Swarthy.' It is in Kirk Michael church vestry-room, having been removed from the church wall.

"No. 9.—This cross, which stands in Andreas churchyard, is in a very perfect condition, and bears the following inscription:—'Sandulf ein Suarti raisti krus thana aftir Arin Biaurg kuina *sina*,' i. e. Sandulf the Swarthy erected this cross to his wife Arinbjorg. It is covered with representations of the animals of the chase, and of domestic use, as the deer, boar, horse, cow, goat, swine, dog. At the base is a female figure on horseback, perhaps Arinbjorg.

"No. 10.—A very rude cross at Onchan. The inscriptions are much effaced, but seem to be—' . . . sunr raiste aftir (Iliæ) suia markibter—ukikat asuer athigrnt.' On the other side, at the head of the cross, we have the word—'krus;' and further down 'I su Krist;' and on one side, 'Thurith raist runir Thurith,'—engraved in runes.

"No. 11.—Cross at Kirk Onchan, probably of the same age as No. 6.

"No. 12.—Fragment of cross at St. John's, near the Tynwald Hill, the inscription along the side is—'Ino I rvir raist runar thenr after.' . . . .
Ino Irvir engraved these runes to, &c.

"No. 13.—Representation of the Passion of our Lord, from the Calf of Man, partly restored. On the left hand of

the cross probably was another figure, with a sponge on a reed.

"No. 14.—A cross partly restored from fragment on the church wall of Kirk Michael. Along the broken edge is the inscription—'Suak raiste krasthana aft rumur . . . . al.' . . . Suak erected this cross to Rumun. It is probably of the same age as No. 3."

Dr. Petrie made some observations on Mr. Cumming's communication.

The Rev. Dr. Todd read the following letter from J. O. Westwood, Esq., on the importance of making a collection of rubbings of the inscribed stones of Ireland.

"*Hammersmith*, *6th April*, 1854.

"My dear Sir,—During my visit to Dublin, last autumn, I was greatly grieved to learn that many of the curious inscribed and carved stones of Clonmacnoise, Glendalough, and other localities, of which descriptions and figures (more or less perfect) had been published, have, within the last few years, been entirely destroyed, without any further record being preserved of them whereby doubts which might arise respecting the correctness of the descriptions or figures might be solved.

"Now, it appears to me that it is one of the especial offices of the Royal Irish Academy to rescue, from absolute or partial oblivion, the class of monuments to which I allude; and I know of no more effectual mode of doing so than to form as complete a collection of rubbings of these stones as possible. Of the Ogham stones, I believe, a complete collection of rubbings has been formed by the Rev. Charles Graves, which, I trust, may ultimately be deposited in the Academy's collection; but the formation of a series of the inscribed and carved stones is a far more extensive matter, and one which requires a certain amount of organization. It appears to me, that the Society would be acting most beneficially towards this end,—

first, by making as extensively known as possible the simplest means of making rubbings of such kind of monuments; and second, by employing some competent person, for a certain period, in visiting the *old* localities, and making such rubbings; or by issuing printed instructions to the incumbents of the outlying districts, setting forth the wants of the Academy, and the means of supplying them in this respect. From my own practice I am inclined to consider, that the old plan of heel-ball and cartridge paper is not the best which can be adopted for the process. I have myself found that the powdered black lead used for cleaning grates, &c., used with a hard leather rubber (an old glove stuffed with tow or hay will make an excellent substitute), is more effectual for producing a representation of the rough surface of stones, especially when rubbed upon common cap paper, such as is sold for lapping up grocer's parcels, &c. A still simpler process has been adopted by Mr. O'Neill, and as it can be employed in cases where the black lead and leather ball are not at hand, it is worthy of being recorded. Mr. O'Neill simply uses a ball of grass, which must, however, not be wet nor too juicy, and the paper must not be thin or porous, as the moisture of the grass brought out by the friction in making the rubbings would, of course, rub holes in the paper.

"Considering, as I do, a collection of these rubbings of very great value, as enabling us to correct the representations of such stones which have already been published, and as forming an unimpeachable collection of figures of the monuments themselves, I hope you will use your influence with the Academy in undertaking the commencement of a systematic collection of these rubbings. I have myself done so with the carved and inscribed stones of Wales to a very considerable extent, and have also, whenever occasion offered, made rubbings of the more deeply carved crosses, although my rubbings show only the highest portion of the sculpture, giving, of course, no idea of the depth of the relievo. Still, I thus obtain a general idea

of the size of the cross, and the distribution of the figures carved on it, which I have also found extremely useful in testing and correcting drawings made by the eye, of the objects in question. During the Great Dublin Exhibition, I thus formed rubbings of several of the crosses, and casts of crosses, exhibited in the central avenue, and in doing so I had occasion to examine very carefully the sculpture upon the smaller of the two great crosses of Monasterboice, which enables me to correct the description of it given by Mr. J. D. Chambers in the "Ecclesiologist" for October, 1848, and at the same time to give an explanation of one of the figures which appears to have been hitherto unnoticed. Our Lord is represented in the centre of the east side of this cross, not seated on His throne of judgment, but standing erect with a cross in the left hand, and a sceptre, with a double scroll at the top, in His right hand. On the arm of the cross to His right-hand side is represented a number of figures approaching Him (according to the words, 'Come ye blessed')—whilst on His left hand, a number of figures are driven from His presence—('Depart ye wicked')—by a fiend armed with a three-pronged fork, and by another figure who holds a book, and kneels on one knee, kicking the figure in front of him with the other leg. Between these two fiends is represented a short, squat figure, with outstretched limbs, which appears to me to be intended as a representation of one of those singular sculptures termed 'shéela na gigs,' to which it bears a perfect resemblance, and which is here represented in its appropriate position, supposing it a personification of vice. Beneath the feet of our Saviour is a compartment occupied by a representation of St. Michael weighing, in a huge pair of scales, a smaller figure, the balance preponderating in his favour; but beneath the scales lies the fiend, who is endeavouring to pull down the lighter scale—a mode of representing the weighing of souls, common in mediæval illuminations, which Mr. Chambers has incorrectly described. Immediately beneath this group the Adoration of the Magi is

represented, which I here notice, as Mr. Chambers says that amongst the designs on the crosses 'there does not appear the ordinary representation of the Blessed Virgin with the Holy Child in her arms, nor, we believe, is it to be found in Ireland.' On several of the crosses also, as that at Moore Abbey, is the flight into Egypt represented, the Blessed Virgin holding the Child in her arms, as usual. Another group of figures common on the Irish crosses appears to me also to have been mistaken, as to its design, by Mr. Chambers. I allude to that of a figure standing with several animals on each side, from head to foot, ready to tear him. Mr. Chambers considers this to represent our Saviour attacked by fierce wolves or dogs—('Many dogs came about me, they gape upon me as a roaring lion.') It appears to me to be rather intended for a representation of Daniel in the lion's den.

"I remain, my dear Sir, yours very truly,

"Jno. O. Westwood.

"*The Rev. Dr. Todd.*"

Sir W. R. Hamilton communicated extracts from two letters which he had lately received on the subject of the last bright comet, from Mr. Andrew Graham, Astronomical Assistant in the Observatory of E. J. Cooper, Esq., at Markree, and discoverer of the planet Metis:—

"*Markree Observatory, Collooney,*
"28*th April*, 1854.

"Your observations of the comet have come to hand today. They will be to me valuable, as I hope to find leisure for further researches on the orbit. Last night was cloudy, and, having made some previous preparations, I was tempted to obtain a second approximation to the elements. At half an hour past midnight I obtained a very satisfactory verification. The observations selected were those made at Markree, March 30th, and April 15th, and at Paris, April 7th, viz.:—

1854.	Greenwich Mean Time.	Appar. α.	Appar. δ.
March 30	·369639	$1^h\ 22^m\ 27^s{\cdot}34$	$+\ 19°\ 37'\ 14''{\cdot}3$
April 7	·324534	3 7 57·46	13 17 3·9
,, 15	·371142	4 13 16·36	5 44 2·4

The corrections for aberration and parallax were obtained by the aid of my first set of elements, which, as it happens, appear to be unexpectedly near the truth. To save you the trouble of reference, I here place the two sets side by side.

	First Approx. Greenwich M. T.	Second Approx.
T	March 24·01183	March 24·01376
π	214° 3′ 27″	213° 50′ 8″·9
☊	315 34 50	315 28 16·1
i	82 42 26	82 30 17·4
log q.	9·44192	9·442544
	Retrograde.	Retrograde.

"The second set of elements are referred to the mean equinox of April 0·0. The most remarkable circumstance connected with them is, that the observations are *precisely* represented by them: the correction of the calculated middle place, to reduce it to the observed, is

+ 0″·1 in longitude, and + 0″·3 latitude.

I do not recollect that in all my calculations I have ever known a parabolic orbit to agree so closely with the observations on which it was founded.

"You probably recollect that the first set of elements are founded on the Markree observations of March 30, April 1, and April 3.

"If you think these results worth laying before the Royal Irish Academy, at their next meeting, may I trouble you to do it? I can easily make the communication somewhat longer if you judge it necessary, by entering more into the details: but, perhaps, the whole affair may be too trifling to occupy a moment's attention. Is not the perfect coincidence

of the parabolic hypothesis with three complete observations very remarkable?"

"*Markree Observatory, Collooney,*
"*5th May,* 1854.

"DEAR SIR,—A set of elements can hardly be regarded complete without the addition of the constants for facilitating the computation of the heliocentric co-ordinates. They are here subjoined,—

$$x = a \sin(\mathrm{A} + v) \sec^2 \tfrac{1}{2} v$$
$$y = b \sin(\mathrm{B} + v) \sec^2 \tfrac{1}{2} v$$
$$z = c \sin(\mathrm{C} + v) \sec^2 \tfrac{1}{2} v$$
$$\log.\ a = 9{\cdot}2990850 + 20{\cdot}0\, d$$
$$\log.\ b = 9{\cdot}3470892 - 12{\cdot}4\, d$$
$$\log.\ c = 9{\cdot}4044724 - 2{\cdot}8\, d$$
$$\mathrm{A} = 198^\circ\ 56'\ 54''{\cdot}2 - 0''{\cdot}25\, d$$
$$\mathrm{B} = 334\ \ 54\ \ 32\ {\cdot}5 - 0\ {\cdot}57\, d$$
$$\mathrm{C} = 82\ \ 53\ \ 25\ {\cdot}7 + 0\ {\cdot}28\, d$$

1854. Greenwich Mean Time.	Values of d.		
T = March 24·01376	March 22,	−0·77	
			1·04
$\log \frac{1}{q^{\frac{3}{2}}} = 0{\cdot}8361840$	April 1,	+0·27	
			1·08
	11,	+1·35	
			1·19
$\log m = 0{\cdot}7963117$	21,	+2·54	

v = True anomaly.
m = Mean daily motion, if Barker's table be used.
q = perihelion distance.
T = time of perihelion passage.

"The longitude of the ascending node was diminished 16″, in deducing the constants from the elements: this referred the axis of x nearly to the *apparent* equinox of March 31; the small equations annexed will reduce precisely to the ap-

parent equinox of the date. The coefficients of d after log a, &c., have for unit the seventh decimal place. The obliquity of the ecliptic has been assumed invariable, and equal to 23° 27′ 34″·6.

"It appeared to us that the diminution of the comet's light was much more rapid than theory would indicate. On March 30, it shone as a good second magnitude star; on April 15 certainly not more than ninth; at least, such was Mr. Cooper's impression* as well as my own. A comparison of the distances from the earth and sun, at these two dates, gives the light on April 15, 6·4 times less than that on March 30, which would be perhaps equal to that of a star of fifth or sixth magnitude. I am not aware that this circumstance has been noticed with regard to the present comet, and therefore venture to direct attention to it as having an important bearing on the physical theory of these remarkable bodies.

"One is still disposed to sift the probability of a collision with the earth or one of her sister planets. We are certainly out of harm's way so far as this comet is concerned. It was in ascending node on March 1, at 22^h 13^m, astronomical mean time at Greenwich. Distance from the sun, 66,193,000 miles; therefore, 3,259,000 miles within the orbit of Venus. It was then nearly 157 millions of miles from us. It was in descending node April 4^d 22^h 46^m. Distance from the sun, 43,973,000 miles; nearly 12 millions of miles without the orbit of Mercury. It was then nearly 83 millions of miles distance from the earth. The comet was in perigee April 1^d 8^h; distance, 80,600,000 miles.

"The only thing worthy of notice, with regard to the computations, is, that in correcting the elements Laplace's method failed. The cause is easily explained. For the middle time the angle at the comet, formed by lines drawn to the

* Such, Sir W. R. Hamilton stated, was also the impression of his Assistant, Mr. Charles Thompson, and his own, on the evening above referred to.

earth and sun, was nearly right, so nearly that an increase of one-tenth of a day in the perihelion passage gave an impossible value for the sine of this angle. The orbit and all the circumstances were particularly favourable for Newton's method; which was, therefore, applied with considerable modifications.

"Without a complete discussion of all the observations the result cannot be regarded as final. It is, therefore, needless to dwell upon the subject, at present, to any greater length. Part of what is here inserted may be too commonplace to bring before the Academy. You will oblige me by pruning as you judge proper.

"The rate of motion at the perihelion was fifty-one miles per second.

"With sincere thanks for your kind encouragement,

"I am very truly yours,

"Andrew Graham.

"*Sir W. R. Hamilton,*

&c., &c."

The Rev. Charles Graves made the following communication on the comparison of adjectives in the ancient Irish language:—

"The most eminent Irish grammarians have constantly denied the existence of a superlative form, as distinguished from the comparative. I was, therefore, surprised to find some undoubted instances of the use of a distinct superlative form occurring in an ancient Irish tract, in the study of which I was engaged more than two years ago; and since then I have continued to collect such other examples of this kind as I met with, intending to bring the subject under the notice of the Academy.

"On looking, however, to the 'Celtic Grammar,' lately published by Professor Zeuss, I found that I had been anticipated by that learned and accurate scholar in the statement of this fact. He shows that in the old Welsh language there was a superlative ending in *am*, of which he adduces *hinham*,

sup. of *hen*, old, as an instance. This final *m* passed into *f* in the later Welsh, which furnishes several examples of superlatives in *af.* In the old Armoric, too, we meet with superlatives in *af* or *aff*, though in the language as spoken at present the termination is reduced to *a*.

"To the old Irish superlatives enumerated by Zeuss ('Gram. Celt.' p. 287), the following may be added:—

amram, ...	sup. of	amra,	admirable.
andum, ...	„	andaċ?	bad.
annsam, ...	„	annsa,	difficult.
ardam, ...	„	ard,	high.
cainem, ...	„	cain,	delightful.
crinem, ...	„	crion,	old.
glaisim, ...	„	glas,	gray.
gruidem, ...	„	gruid,	bitter.
millsem, ...	„	milis,	sweet.
moorom, ...	„	mor,	great.
sinem, ...	„	sen,	old.
sruiċem, ...	„	sruiċ,	distinguished.
tindem, ...	„	teann,	strong.
treisim, ...	„	treis,	strong.
uaislem and uaislium, . . .	„	uasal,	noble.

"Amongst these will be observed two in *im*, and two in *um*, terminations of which Professor Zeuss seems to have met with no examples."

The Rev. Samuel Haughton read an account of some experiments made to determine the velocities of the rifle bullets commonly used.

The Chairman remarked, that such papers as that read by Mr. Haughton, combining both the highest science and the most exact practical knowledge, were of the greatest national importance.

Sir W. R. Hamilton, having been lately induced to consider, in connexion with the Calculus of Quaternions, the celebrated theorem of Dupin, respecting the character of the intersection lines of three systems of orthogonal surfaces, as lines of curvature thereon, stated that he had thus been led to perceive some symbolical results which he supposed to be new, and which seemed to him to be of sufficient interest to be submitted to the Academy.

As long ago as 1846, he had proposed the notation,*

$$\lhd = i\frac{d}{dx} + j\frac{d}{dy} + k\frac{d}{dz};$$

and had pointed out a theorem,† differing only slightly in its expression from the following:

$$V.\alpha V.\beta\gamma = \gamma S.\alpha\beta - \beta S.\alpha\gamma;$$

which may also be thus written,

$$V.\alpha(V.\beta\gamma) = S.\alpha\beta.\gamma - \beta S.\alpha\gamma,$$

or thus,

$$V.\alpha(V.\beta\gamma) = S.\beta\alpha.\gamma - \beta S.\alpha\gamma.$$

The recent results just referred to have a remarkable symbolical resemblance to those comparatively old ones, since they admit of being written thus:

I. . . . $V.\alpha(V.\lhd\nu) = S.\alpha\lhd.\nu - \lhd S.\alpha\nu;$

II. . . . $V.\lhd(V.\beta\nu) = S.\beta\lhd.\nu - \beta S.\lhd\nu;$

where $\lhd$ is *not* an ordinary *vector*, but a certain *symbol of operation, analogous to a vector*, in its combinations with other symbols, and defined by a foregoing formula: while α and β are constant vectors, and ν is a variable vector, regarded as a

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* See Proceedings of the Academy for July, 1846.

† See Philosophical Magazine for August, 1846.

function of xyz, or of $\rho = ix + jy + kz$, and subject as such to the operations $\lhd$, $S.\alpha\lhd$, $S.\beta\lhd$; where

$$S.\alpha\lhd = -\left(a\frac{d}{dx} + b\frac{d}{dy} + c\frac{d}{dz}\right),$$

if $\alpha = ia + jb + kc$, and the symbol $S.\beta\lhd$ is similarly interpreted.

These were among the chief elements of calculation employed, in proving by quaternions the theorem above mentioned of Dupin; of which one expression, in the quaternion calculus, is the following :—

"If the three differential equations,

$$S.\nu d\rho = 0, \qquad S.\nu' d\rho = 0, \qquad S.\nu\nu' d\rho = 0,$$

be integrable, and if $S.\nu\nu' = 0$, then the supposition $V.\nu' d\rho = 0$ conducts to the equation $S.\nu\nu' d\nu = 0$."

Another expression of the same theorem is as follows :

"If $\qquad S.\nu\lhd\nu = 0, \quad S.\nu'\lhd\nu' = 0, \quad S.\nu''\lhd\nu'' = 0,$

and $\qquad V.\nu\nu'\nu'' = 0,$

then $\qquad S.\nu''(S.\nu'\lhd.\nu) = 0.$"

In this last formula, the symbol $S.\nu'\lhd.\nu$ denotes a vector having the direction of $-d\nu$, if $d\rho$ have the direction of ν'; and the equation expresses, that if we thus move a little along the first surface in the direction of the normal to the second surface, the new or near normal to that first surface will be contained in the tangent plane to the third surface, and therefore will intersect the old normal to the first surface: which is a form of the theorem of Dupin.

Although not very closely connected with that well-known theorem, Sir W. R. H. wishes to add that another old form of his, for any three vectors, namely,

$$V(V.\gamma\beta.\alpha) = \gamma S.\beta\alpha - \beta S.\gamma\alpha,$$

has suggested to him this new symbolical result,

III. . . . $\qquad V(V.\gamma\lhd.\nu) = \gamma S.\lhd\nu - \lhd S.\gamma\nu;$

and that each of the three general theorems, expressed by the formulæ I. II. III. of this Abstract, can be proved to continue to be true, when his old signification of the symbol $\triangleleft$, to which Mr. Carmichael's researches have lately given an additional interest, is changed to this other and more extensive signification,

$$\text{IV.} \ldots \qquad \triangleleft = i\delta_1 + j\delta_2 + k\delta_3 ;$$

where $\delta_1\ \delta_2\ \delta_3$ are three new distributive symbols, operating on functions of xyz, and commutative (in order) not only with any ordinary and scalar constants, but also with ijk.

The Secretary of the Academy presented the following donations:—

No. 1.—Captain Borrowes, Gilltown: a squared block of syenite, with a border of hieroglyphs, containing the name and title of the Egyptian king, called Sesuntesen III., by Lepsius. Dr. Todd read a letter from Dr. E. Hincks, in which he explained that the inscription contained the five titles borne by Egyptian kings, and three others, viz.:—1. "Beloved by Nû, or Noum, lord of the cataract (?)." 2. "Beloved by Sate, lady of Elephantine;" there being local deities worshipped at Elephantine. 3. "Beloved by—un (or hwn) who dwells in Nubia." Dr. Hincks states in his note, that he never recollects to have seen the name of this deity before, and that he cannot read the hieroglyph which represents two fishes, at the commencement of this name.

Colonel Larcom explained that the interpretation of the inscription made by Dr. Hincks was most satisfactory, as he had been informed by Mr. Borrowes that he obtained the stone from a Coptic convent, situated very far up the Nile; but he hoped to get for the Academy all the particulars concerning the place and circumstances of the discovery of the stone from the donor, in a few days.

No. 2. From the Academie des Jeux Floraux, at Tou-

louse: two medals, one in bronze, and one silver, forwarded by the Viscount de Mac Carthy, M.R.I.A., &c.

3. The seal of William, Lord Bishop of Limerick, Ardfert, and Aghadoe, 1849, presented by the Lord Bishop of Derry.

Monday, May 22nd, 1854.

LIEUT.-COL. LARCOM, F.R.S., Vice-President, in the Chair.

The Secretary read the following paper, by Mr. J. Beete Jukes, on the barometrical measurement of the Peak of Teneriffe.

"On the 1st of May, 1842, I ascended the Peak of Teneriffe, in company with the late Captain F. P. Blackwood, R.N., then commanding H.M.'s surveying Ship, Fly, and (Lieutenant, now) Capt. C. F. A. Shadwell, C. B. We carried with us a Newman's mountain barometer, the neutral point of which was stated at 29·742, attached thermometer 60°, its relative capacity of tube and cistern $= \frac{1}{52}$, and the correction for capillary attraction at ·041. We also took a Mason's hygrometer and a Wollaston's barometric thermometer, on which, however, only one observation was made before it was broken.

"We started at seven in the morning, from the Posada in Oratava, halted at mid-day, at a spot called by the guide 'the Cañada,' slept at the place called the 'Estancia de los Ingleses,' on the flank of the cone, reached the summit by sunrise, and returned to Oratava at two in the afternoon of the next day.

"The following were the observations made:—

"(1) May 1, inn at Oratava, at seven A.M.—Barometer, 30·250; attached thermometer, 70°; detached thermometer, 70°.

"(2) Noon at the Cañada.—Barometer, 23·926; attached thermometer, 66°·5; detached thermometer, 58°.

"(3) At 4 P.M. at the Estancia de los Ingleses.—Barometer, 21·434; attached thermometer, 59°; detached thermometer, 55°; Mason's hygrometer, wet bulb, 36°, dry bulb, 52°; water boiled at 194° of the barometer thermometer, at 5 P.M., when the temperature of air had sunk to 47°.

"(4) May 2, at 6 A.M. on the summit of the Peak.—Barometer, 19·803: attached thermometer, 54°; detached thermometer, 42°;* Mason's hygrometer, wet bulb, 33°, dry bulb, 42°.

"Contemporaneous observations were taken this morning at Santa Cruz, by Mr. Evans, of H. M.S. Fly, on a similar barometer, the neutral point of which was 30·257; relative capacity $\frac{1}{50}$, the observations being—

"(5) Barometer, 30·212; attached thermometer, 70°; detached thermometer, 70°.

"(6) At 10 A. M. at the Estancia, on descending.—Barometer, 21·438; attached thermometer, 59°; detached thermometer, 50.

"(7) At 4 P. M. at the inn at Oratava.—Barometer, 30·235; attached thermometer, 75°; detached thermometer, 73°.

"Correcting these observations for relative capacity and capillary attraction, we get the following:—

	Barometer.	At. Ther.	Det. Ther.
(1)	30·300	70°	70°
(2)	23·856	66 ·5	58
(3)	21·316	59	55
(4)	19·653	54	42
(5)	30·252	70	70
(6)	21·320	59	50
(7)	30·285	75	73

* There were hot rocks from which vapour issued not many yards from us; as snow remained unmelted a little below, the general temperature of the air could hardly have exceeded 32°.

"Calculating the differences of altitude from these observations by the tables and formula (Bailey's) given in Simms's 'Treatise on Mathematical Instruments,' we get the following:—

			J. Feet.	H. Feet.
Difference of level between		(1) & (2) =	6·712	6·673
Ditto,	ditto,	(2) & (3) =	3·094	3·093
Ditto,	ditto,	(3) & (4) =	2·197	2·191
Ditto,	ditto,	(4) & (5) =	11·880	11·826
Ditto,	ditto,	(4) & (6) =	2·192	2·195
Ditto,	ditto,	(6) & (7) =	9·841	9·720
Ditto,	ditto,	(4) & (7) =	11·930	11·877

"The numbers given in column J. are from my own calculations; those in column H. are from the calculations of Professor Haughton, who has been kind enough to make them for me 'from the formula in the "Annuaire du Bureau des longitudes," with the exception of the correction for the temperature of the air, which is taken from Rudberg's coefficient (viz., $\frac{1}{492}$).'

"Observations Nos. 1 and 7 were taken at the same spot in Oratava, the height of which was estimated at 45 feet above the sea. Observation No. 5 was taken in Santa Cruz, at a probable height of 50 feet above the sea.

"The total height of the Peak, therefore, will be as follows:—

"By the observations taken in ascending on May 1, and the morning of the 2nd—

J. (45 + 6712 + 3094 + 2197) = 12,048 feet.
H. (45 + 6673 + 3093 + 2191) = 12,002 „ (A)

By the observations taken in descending on May 2—

J. (2192 + 9841 + 45) = 12,078 feet.
H. (2195 + 9720 + 45) = 11,960 „ (B)

By the simultaneous observations on different instruments, and by different observers, on May 2:—

J. (11880 + 50) . . . = 11930 feet.
H. (11826 + 50) . . . = 11876 „ (C)

By calculating from the two observations on same day taken at summit and Oratava—

J. (11930 + 45) . . . = 11975 feet.
H. (11877 + 45) . . . = 11922 „ (D)

"The mean of these values A, B, C, D,

= 12008 feet, by my calculations.
= 11940 feet, by Professor Haughton's calculations.

"I may add, that the weather was fine and settled, with a stratum of clouds at about the height of 5000 to 6000 feet, above which the atmosphere was perfectly clear. The wind on the summit, at 6 A.M. on the morning of the 2nd, was very light from N. by E., while, at Santa Cruz, at the same time, it was blowing rather freshly from the N. E.

"On the 28th, as we approached the island, with fine clear weather and a light breeze, Mr. Evans, Master of H.M.S. Fly, took trigonometrical observations on the Peak with a sextant, measuring a base with the patent log. The results of these observations gave a height of 12,105 feet for the height of the Peak.

"The heights assigned by Humboldt, who did not himself make any observations, are for the

	Torsis.	Feet.
Estancia de los Ingleses,	1552 =	9921
The summit of the Peak,	1909 =	12204

"The two values deducible from our preceding observations, for the height of the Estancia, are 9886 and 9851, the mean of which = 9868, which only differs by 53 feet from that

of Humboldt, although there is a difference of 200 feet in the height of the summit.

"Von Buch gives the following barometrical observations for the height of the summit:—

	Barom.	At. Ther.	Det. Ther.
On the Peak, . . .	19·801 . .	60° . . .	52°
At Santa Cruz, . .	30·173 . .	84 . . .	82

From which, using the same method of calculation as before, I should deduce a height of 11,850 feet.

"If now we take all these observations as independent values, namely—

Our mean . . .	= 12·008 by my calculations;
Mr. Evans's, . .	= 12·105
Humboldt's height,	= 12·204
Von Buch's, . .	= 11·850

we shall find the mean of the whole to be 12,042 feet.

"On taking our mean by Professor Haughton's calculations at 11·940, we shall get the resulting mean = 12·029 feet.

"These means agree very closely with the heights deduced from our observations taken in ascending, when we divided the whole height of the mountain into three stages; and the difference between Professor Haughton's calculations and mine is less for those three observations than for the others. Whether these considerations would be sufficient to give a preferential value to those observations I will not pretend to decide.

"There is yet one other consideration:—Our two heights of the Peak above the Estancia de los Ingleses, whichever way they are calculated, agree within six feet. They may, therefore, be looked on as very approximately true, and their mean is 2193 feet. The mean of the five values (including Humboldt's) for the height of the Estancia de los Ingleses is 9847 feet, which, added to 2193, gives a total of 12,040 feet for the height of the Peak.

"The difference between this last value and the former one

is, that it depends on our observations alone, with the single addition of Humboldt's height of the Estancia, leaving out the two extreme values given by Humboldt and Von Buch, for the height of the Peak, and also for the trigonometrical value obtained by Mr. Evans. If we leave out of the calculation Humboldt's height for the Estancia, it would reduce our mean to 12,021.

"It would appear probable from the foregoing remarks that a little over 12,000 feet is very probably the real height of the famous Peak of Teneriffe."

Mr. J. Huband Smith exhibited a curious slip of large bone found in a cottage in the parish of Donabate, county of Dublin, on which was engraved a coat of arms and several figures of men and animals, referrible to the beginning of the reign of Elizabeth.

Rev. Dr. Todd presented, on the part of Robert Smith, M. D., the cast in plaster of an inscribed stone, situated near Sneam, in the county of Kerry, containing some curious concentric circles and other marks.

MONDAY, JUNE 12TH, 1854.

HUMPHREY LLOYD, D.D., VICE-PRESIDENT,
in the Chair.

IT was Resolved, on the recommendation of the Council, that the sum of £80 be granted for the purchase of Mr. Richard Murray's collection of Irish antiquities.

Mr. Charles Haliday read a paper on the ancient name of the city of Dublin.

Rev. Charles Graves, D. D., read the following letter from Charles MacDonnell, Esq., relative to the MSS. of the celebrated John Colgan, preserved at St. Isidore's, Rome:—

"The catalogue from which I copied the following is in the archives of the Irish Franciscan Convent of St. Isidore, Rome. There are several copies of it there.

"It will throw some light upon the subject of Colgan's collection of Irish MSS., some of which are in the Burgundian Library, some at St. Isidore's; but many of which are missing, and, probably, irrecoverably lost. The French soldiers, in the time of Napoleon I., used the Convent of St. Isidore for a long period as barracks. Let us hope, however faintly, that some fragments of this collection may have been transferred, at that time, to other libraries, for the second volume of the autograph exemplar of the Four Masters, formerly at St. Isidore's, is now in the Barberini Library, and nobody can tell when or how it came there. The friars have the first volume still.

"There is still another chance. Several years ago, but subsequent to the erection of the Belgian kingdom, a number of printed books that had belonged to the Irish Franciscans of Louvain, were brought from Belgium by an Irish friar of that

order, and deposited in the Library of the Franciscan Convent at Wexford. Perhaps he may have brought over some MSS. also. I saw the printed books; there are some of scarce old Irish authors among them, chiefly theological and philosophical; but I did not get access to the archives, and consequently could not ascertain whether any part of Colgan's MSS. be among them.

"There are some papers at St. Isidore's that formerly belonged to the Irish Franciscans at Louvain, bearing dates as late as 1791.

"CATALOGUS MANUSCRIPTORUM TAM LATINÈ QUAM HIBERNICÈ, OLIM IN CAMERA R. P. COLGANI REPERTORUM, QUIBUS POSTEA R. P. SIRINUS USUS FUIT.

MSS^a. HIBERNICA IN PERGAMENO.

A. Vita Xp̃i, in folio.
ita alia, in 4°. magno.
Liber vulgo leaḃar ceapc appellatus, in 4°.
Grammatica Hibernica, in 4°.
Liber, in 4°., de Inventione S^ta. Crucis et variis aliis.
Liber alius similis de actis Caroli Magni, SS. Patricii Molingi Becani aliorumqȩ quorumdam SS^rum.
Liber de Bello sive Caṫ ṁuiᵹe leṁna, in 4°. magno.
Vita S. Columbæ, in folio.
Aᵹallaḋ na ꞅeneoꞃaċ, in folio. B.
Liber Hymnorum partim Latinè partim Hibernicè.
Liber alius metricus gracilis et oblongus.
Vita S. Kierani, in 4°.
Vita S. Margaretæ, in 4°.
Folia aliquot Hibernica, aliquot Latina.
Martyrologium Tamlachtense, sed mũtilum, cum opusculis S. Ængussii, in folio. *Est con^tus Dungallensis. a.*
Martyrol. Cathaldi Maguir sive Ængussius auctus, in fol. *Est con^tus Dungallen.*

MSSa. in Papiro.

B. Liber magnus, in fol. continens Martyrolm. partim Hibernice partim Latine.

Calendarium Casseliense, in folio.

Martyrolm. Dungallense, in 4°. et aliud exemplar, in 8°.

Liber, in 4°. continens Martyrologia S. Ængussii, Mariani Gormani, Tamlachtense, Genealogias SSrum. metrice, et plura alia opuscula, fol. 3°. videnda.

Liber, in 4°. scriptus partim Latinè partim Hibernicè, continens catalogum SSrum. et virûm illustrium Hiberniæ orde. alphabetico, opusculum S. Ængussii de matribus SSorum. genealogias Sanctor. orde. alphabetico.

Collectanea, in 4°. orde. alphabetico de SStis. Hiberniæ ex variis, quibus facilè inveniuntur Authores et SSrum. vitæ in quibus fit aliqua de ipsis mentio. Hic includitur catalogus Pr̃is Fitzimonis.

Libellus similis, in 8°. Hibernicè Scriptus.

Liber, in 8°. continens Martyrol. Dungallense. Quædam excerpta ex Martyrologiis Carthusianorum, etca.

Liber, in 4°. continens genealogias Regum et SSrum. in quo includitur charta continens geneal. SSrum. orde. alphabetico. Est etiam aliud exemplar in 8°.

Liber, in 4°. continens genealas SSrum. metricè, cum opusculo de uxoribus et matribus filiorum Milesii et successorum.

Libri tres, in 4°. continentes Acta SSrum. Hibernicè; cum aliis multis in Indicibus videndis.

Liber, in 4°. continens M. Tamlactense, marginalia ejusdem et opuscula de matribus SSrum.

Liber pergameneus, in 4°. continẽs varias visiones, in indice videndas.

C. Libri undecim, ex quibus octo in 4°. cum uno longo libro, continentes Collectanea ex diversis. Inter quæ *Extracta ex monasteriis Scotorum in Germaniâ* partim impressa partim MSSa.

Liber, in 4°. continens catalogum SSrum. orde. alphabetico.

Libelli Filiationum et Homonymorum S. Ængussii, in 4°.

Libri duo, in 4°. cum aliis chartis continentes nomina Ecclesiarum et Locorum Hiberniæ.

D. Liber, in folio, continens Ampa Columm cille. Morðail Droma ceat. Agallað an dá ḟuað.

Liber, in fol. continens Vitam S. Columbæ Kille Hibernicè.

Historia Doctoris Keting, in folio.

Agallað na seneorað, et Poëmata Finn ṁ Cumaill, in fol. est in Bibliotheca.

Annalium Hiberniæ Quatuor Magistrorum Hibernicè (communiter *Annales Dungallenses* appellati quia in conventu Dungallensi scripti) duo tomi, in fol. cum indice eorumdem, in folio, et alio indice, in 4°.

An leabar gabala, in 4°. Idem ar na ġlanað, in 4°. Idem incompactus, in 4°.

Liber, in 4°. continens quædam ex leabar gabala. Genealogias quorumdam. Chronicon MacDonellorum Albaniæ.* Matres SS^{rum}. quorumdam.

Libellus parvus continens Poëmata Triallam timċiol na fodla. Tuille fesa ar Eirinn óiġ. Crioċ Orraiġe Leċ Laiġen.

An iomarbaið iðir Taðg ⁊ Lugaið, ubi sinior an tſenċair.

Liber, in 4°. continens collectanea ex Historiis Hibernicis et aliis scriptis, de Regibus Hiberniæ tam Monarchis quam Provincialibus. De Regibus Albaniæ. In hoc libro inclusa est charta continens Coṁaimserað Rioġ Eireñ, Alban, et^{a}.

E. Liber, in 4°. continens Caṫ muiġe mucroiṁe. Nuallġuba Oileal Oloim. Do riġe Cormaic ṁ Airt. Do na tri Cairbri. Beṫa Ronain ⁊ buile Suibne. Caṫ ros na ríoġ ór boiñ. Beṫa Patraic. Beṫa Briġiðe. Inneall an gaoi bulga. Chronicon breve apocriphum. Imteaċa Nuaða neaċtṁair.

Liber, in fol. continens vocabularium etymologicum Hibernicum.

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* If this Chronicon Mac Donnellorum Albaniæ be still anywhere extant, it will, doubtless, throw new light upon many events of Scottish and Irish history. A search ought to be made among the MSS. in Edinburgh for a copy.—Charles P. Mac Donnell.

Liber, in fol. continens variarum vocum explicationem.

Liber similis sive tres terniones, in 4°.

Liber, in 4°. continens varia Poëmata Hibernica. Stair Triar mac rí na hIoruaide. Comrac Firdiad 7 Concculuinn.

Liber, in 4°. continens Eachtra Neachtain m Nuadat. Blad do Betha Chriost. Visio Tundali. Sceóil fríoródalta, et alia in fine videnda.

Liber, in 4°. continens Agallad na Seneorach. Cath catharda. Imtecht na Noinmhided.

Grammaticæ Hibernicæ duo exemplaria, in 4°. aliqui vocant leabar ceart.

Liber, in 4°. continens leabar Ogham. Do meallad cách nó Ua Cearbaill. Leabar uraicepta. Forar focal.

An cath catharda sive bellum civile, in 4°.

Dúanarda seu liber Poëmatum, in 4°. in cujus fine hr̃ Cogad Gaoidheal re Gallaib.

Liber alius Poëmatum, in 4°. Item duo alii, in 4°.

Liber alius, in 8°.

Libellus metricus transversim fractus, et sine cooperculo.

Libellus, in 8°. continens Cath ruis na ríog. Nonnulla de SS[tis]. Ægypti. Do Chonchobar ri Ulladh. Et genealogias Orgielliorum.

Libellus qui Psaltair na rann dr̃, seu Poëma de SS[tis]. in calend°. Romano contentis.

Ternio, in 4°. continens Oilemain an dá mhedar. Imthecht m hua ccorra.

Libellus Poëmatum, in 4°. Authore P. fr̃e Jacobo Niellano.

Exemplaria diversa Grammaticæ Latinè et Hibernicè.

Liber, in 4°. continens indicem Poëmatum et quædam alia Latinè partim, partim Hibernicè scripta.

Liber, in 4°. continens collectanea ex variis Poëmatibus Hibernicis ord°. alphabetico.

Libellus, in 8°. continens hinc inde began do faothar Briain Balluigh. Indices poëmatum, quæ in aliis libris et chartis hnr̃. Catalogus Scriptorum Hiberniæ ex Kettino et Annalibus.

Libellus, in 8°. continens ord°. alphabetico varia Proverbia Hibernica.

Cpı Ċenga maıpc, sive tres libelli genealogiarum

Tres fasciculi continentes diversa Poëmata etca.

Terniores aliquot, in folio, continentes Pocaıl cpuaıbe an leabaıp ċeıpc.

Liber, in folio, in initio et alibi fractus varia tractans. Do gaballuıb Epeñ. Do pıoguıb cloıñe Mıleaḃ pop Eıpıñ. Poëmata quædam. Copaıgeſ Cheallaċaın Caıpıl. Agallaıṁ na Noınbıbe. De decem præceptis Decalogi etca.

Liber Poëmatum O Donelli, in folio.

Cupap na Nſaplaḃ ap Eıpe, in fol.

Liber Poëmatum, in 4°. ubi habñr Genealaċ na Nđoṁ metricè.

Libellus, in 4°. .ı. Sgeul pabuıl le Maelmopḃa ṁ Emuın ua Ragallaıġ. No lé Comap ṁ Sçmoın. [In the original a line was drawn through the words Sgeul pabuıl.]

F. Opus Philippi O Suillevani, in folio.

Opus Joannis Waddingi Sacerdotis Wexfordiensis, in 4°.

Opus Philippi Flatsbury, in 4°.

Opus P. Hugonis Vardæi de SStis. diversis.

Visio cujusdam militis Hiberniensis.

Duæ Historiæ Hiberniæ altera Latinè altera Hibernicè, sed incompletæ, in fol. Item de origine Scotorum. Tabula Chronologica Regni Hiberniæ impressa.

Summarium Actorum quorumdam SSorum.

Patris Vardæi Indigitamentum SSrum. Hiberniæ. Mensis Jan. Martyrologiorum Tamlachtensis et Mariani Gormani cum notis P. Colgani. Notæ P. Colgani in Acta SSrum.

Monasteria Cisterciensium in Hibernia. (De Mõrio Beñchorensi.

G. Vitæ SSrum. ex codice Kilkenniensi.

Vitæ SSrum. ex cod. Insulensi sive Insulæ SSrum. in lacu Rivensi.

Difficiliora et duriora puncta in SSrum. vitis occurrentia, explanata.

Nomenclatura Hiberniæ.

De Regibus Hiberniæ ex Scriptoribus diversis.

Genealogia SSrum.

Chronicon Virorum illustrium ex Annalibus Dungallensibus.

Opuscula S. Ænguesii.

De pluribus Liberis SS^{tis}. eod^{e} p̄re vel m̄re progenitis.

Conditores Regularum Monasticarum.

Catalogus SS^{rum}. Alphabeticus ex Martyrol. diversis.

De M̄ūriis Hibernorum inter exteras Gentes unum volumen.

Synopsis de Apostolatu SS^{rum}. Hiberniæ, tria alia volumina.*

Opus P̄ris Sirini de Sanctis adusqȩ tertium diem Septembris revisum per ipsum usque ad 27 Januar. In istâ revisione proposuit præparare denuō pro prelo oēs vitas SS^{rum}. trium mensium jam impressas apud P̄rem Colganum, additis novis notis, sed Deus aliter disposuit.

I. Vitæ SS^{rum}. duodecim mensium, in 12 fasciculis.

Extracta ex Capgravio, et alia de SS^{tis}. diversis, ex variis Scriptoribus. Sed h̄r Capgravius inter libros impressos. Extracta ex Matthæi Rideri Bavaria Sancta, et ex variis aliis.

. *Acta SS. Patricii, Columbæ, et Brigidæ.*

MSS^{a}. Scolastica P̄ris Colgani. Bullaria duo MSS^{a}.

Liber MS^{us}. continens Catalog. Pontificum, Imperator̄ et^{ca}.

Fasciculus continens quædam de f̄ribus Prōæ Hiberniæ ab hæreticis occisis. De P̄re Michaele Duvin. Vitæ P̄rum Joannis Daton et Joannis Kearny. Synopsis P̄ræ Hiber^{æ}. et^{ca}.

Dictionarium incæptum a P̄re Boetio sive Augustino Ægano, cum Dictionario quo ipse usus fuit. P̄ris Strang tract^{us}. contra Paulum Harris. Claudius super Matthæum. Manent in magna cesta cum multis aliis ibidem videndis.

In minori cesta ejusdem formæ manent aliquot exemplaria Vitæ Scoti Doct. Subtilis. Diversi fasciculi literarum et aliarum chartarum et plura alia ibidem videnda.

In parva cestula ejusdem formæ manent MSS^{a}. Scolastica et alia R. P. Sirini.

In plana cesta h̄ūr literæ Typographiæ. Clavis pendet supra cestam.

In pulpito est unus calix argenteus spectans ad Conventum

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* Vide indicem Synopsis ad literam C.

Dungallers. Parva bursa Reliquiarum aliquot SSrum. Sigillum argenteum spectans ad O Donellum etca.

In Cameris superioribus. In prima manent literæ Typographiæ Hibernicæ in parvâ cestâ et in mensa, cum suis formis. Plura exemplaria Actorum SSrum. Hiber. Triadis Thaumaturgæ. Disquisitionis de S. Rumoldo. Operis R. P. Flemingi de S. Columbano. Legaõis de Immaculata conceptiõe. Operis de statu parvulorum. Ƿoclóıp, cum coriis aliquot pro libris co-operiendis.

In secunda Camera manet magnus cumulus chartarum pro prelo.* Rama istius chartæ constabat 4 flor. et 6 asses in Hollandia jam 35 ad minus annis.

"Then follows, under the heading '*Libri Impressi*,' a catalogue of about 109 items, among which are a great many works treating of Irish matters, proper offices of various dioceses, &c. &c. Among them the following have the note attached: 'Est conventus Dungallensis:' viz.: —

Camden. Anglia Normannia Hibernia.
Florileg. Insulæ SSorum.
Analecta de reb. Hiberniæ.
Bellarminus de Scriptorib. Ecclesiast., in 8°.

"Then there is a further catalogue, in the same handwriting, of books found 'in Camera R. P. Sirini.' Among these, the 'Rndi. D. Francisci Kirovani Alladensis (Cıllala) Epi Vita,' in 8°, has this note subjoined:—'Ipse est qui mihi Diaconatum et Presbyteratum contulit. Ita attestor fr Bonra. Docharty.'

"Near the end is this further list, headed, 'Libri ab antiquo conventui Dungallensi consignati:'—

Anglia Normannia etca. Camdeni.
Logica Pauli Valli.

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* Scapus.

Scotus in 3 et 4 Sententiar.

Ockam in Sententias.

Scot. et Andr. Metaph. (Occami Logica, Erat P̃ris Hugonis Vardæi, non assignatur ulli conventui.)

Joannes Bassoli in 4^or^. lib. Sententiar.

Florileg. Insulæ SS^rum^.

Acta SS^rum^. Virginum Hibernicè.

Scripta logicalia P̃ris Sirini sub P. Thoma Flemingo.

Analecta de rebus Hiberniæ.

Bellarmin de Scriptoribus Ecclesiast.

Quintus Curtius de Alexandro Magno.

Exempla et poëmata pia Hibernicè.

The following notice of a lost work of Colgan, author of the "Acta Sanctorum Hiberniæ," on the early evangelical labours and monastic foundations of the Irish abroad, by Charles P. Mac Donnell, M.R.I.A., was also read:—

"Harris says, in his edition of Sir James Ware's works, which was published in 1745,—'There are several volumes of his (Colgan's) writing yet remaining at Louvain, in MS., of which I have obtained the following titles, by the favour of the late Guardian of that house, viz.:—

Tom. I. De Apostolatu Hibernorum inter exteras gentes, cum indice alphabetico de exteris Sanctis. Folio, consisting of 852 pages.

Tom. II. De Sanctis in Anglia, in Britannia-Armorica, in reliqua Galliâ, in Belgio. Consisting of 1068 pages, but a small part is wanting at the end.

Tom. III. De Sanctis in Lotharingia et Burgundia, in Germaniâ, ad sinistram et dextram Rheni, in Italia. Pages 920. Also some pages are wanting at the end of this tome.

"It is much to be feared that this work is irrecoverably lost. Some of Colgan's MSS. were transferred from Louvain to the Burgundian Library in Brussels, and part to

the Irish Franciscan Convent of St. Isidore, in Rome. The precise date of the transfers I have not been able to ascertain; but I apprehend that much of what was deposited in the archives of St. Isidore's was scattered or destroyed during the French occupation of Rome under Napoleon I., when the convent was used as barracks.

"Beyond the fragment of the Index which I have copied, and subjoin, and a few detached leaves which I believe to have formed part of the work, I have been unable, by a careful search and inquiries, to find at St. Isidore's any portion of that great monument of the learning and research not only of Colgan, but of the many who contributed towards its compilation: for Fleming, Ward, Rooth, the learned Jesuit, Stephen White, and others, had made previous and partial collections, of which Colgan had knowledge, and of which, undoubtedly, he availed himself largely.

"Nor does my recollection of a sojourn of several days among the Irish MSS. in the Burgundian Library supply any trace of anything there which could be part of the work itself; though I remember to have seen there, bound up with other documents, a few leaves of Collectanea, which in all probability formed part of Colgan's materials for it.*

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* To this fragmentary and undigested Collectanea the following item in the catalogue prepared at St. Isidore's, of the MSS. and books found in Colgan's room, and which Sirin subsequently used, has probably reference:—"Libri undecim ex quibus 8 in 4°. cum uno lougo libro, continentes collectanea ex diversis. *Inter quæ Extracta ex Monasteriis Scotorum in Germania*, partim impressa partim MSS[a]." The work itself is mentioned lower down in the same catalogue thus:—"*De mñriis Hibernorum inter exteras gentes*, unum volumen." "*Synopsis de Apostolatu SS*[rum]. *Hiberniæ*, tria alia volumina." And annexed to the item, in the same handwriting as the rest, is a marginal reference back to the above-mentioned "*collectanea ex diversis*" for the index of the Synopsis. It is worthy of remark, that this old catalogue refers to four volumes; Harris only heard of three. Had one volume perished already when he wrote, or had two of the volumes been bound in one? At present one can only conjecture.

"If the work be definitely lost, the loss is in many respects irreparable. When Colgan compiled it, and others collected for it over the Continent, above two hundred years ago, how many a historical tradition was living in the great old monastic institutions of which our pious countrymen were the venerated founders in France, in Belgium, in Switzerland, in Germany, and even in Italy itself! Those reverend memories have long since perished with the institutions themselves; and many a rich store of charters treasured there has been hopelessly scattered or destroyed by the profane and savage hand of ungodly revolution and war. No future compiler can ever fill up the blank left in Irish ecclesiastical history by the loss of this noble record. The 'Gesta Dei per Ibernos'—the action of our missionary countrymen upon the civilization of modern Europe, can never be so gloriously proven.

"Some chances still appear to remain of its existence. A learned French ecclesiastic, conversant with such matters, whose studies frequently bring him to the MSS. department of the Imperial Library in Paris, suggests to me the possibility of this work having been taken thither during the former French occupation of Rome, as containing matter touching upon the history of France. He has offered me his services to make search for it there on his return to Paris; I fear, however, there are but slight grounds to hope it may be found there.

"But another circumstance gives me a brighter ray of hope. A complete autograph exemplar of the Four Masters formerly belonged to St. Isidore's: the first volume is still preserved there; the second is in the rich library of Prince Barberini: how or when it made its way there nobody can tell me. The MSS. in the Barberini Library are undigested, and the catalogue is only now being made out. May not this missing work of Colgan's have found its way,

like the volume of the Four Masters, into that or some other Roman Library?

"Lastly, it would be desirable to search for it in the archive chests of the Franciscan Convent in Wexford Some years after the creation of the kingdom of Belgium, an Irish Franciscan friar obtained in that country as much as then remained of the printed books of the library of the suppressed convent of his order in Louvain, in which Colgan had lived and died; and whence, as we have seen, the Irish MSS. in the Burgundian Library, and much of those at St. Isidore's, were brought. The priest in question deposited these printed books in the convent of his order in Wexford, where I examined them hurriedly about the year 1846. I did not find any MSS. in the library, but it is possible that there may be some in their archive chests, which I had not an opportunity of examining.

Liber IV.

DE MONASTERIIS PRO VETERIBUS SCOTIS SEU HIBERNIS PER SUÆ GENTIS VIROS SANCTOS, VEL ALIOS, EXTRA PATRIAM SUAM OLIM FUNDATIS, VEL EISDEM POST FUNDATIONEM TRADITIS.

Dist. 1.—*De Monasteriis pro Hibernis monachis in Scotia Albiensi fundatis.*

Cap. 1. De Hiensi Archicœnobio, ejusque fundationes ac prærogativis.

Cap. 2. Testimoniis Bedæ et aliorum ostenditur Hiense Monasterium pro Scotis Hibernis fuisse conditum.

Cap. 3. Ostenduntur omnes ferè S. Columbæ discipuli in Monasterio Hiensi et alijs ei subjectis, fuisse genere Hiberni.

Cap. 4. Ex Catalogo Chronologico Abbatum, aliorumque virorum illustrium Hiensis Monasterii ostenditur idem Monasterium à primâ suâ fundatione Circa ann. Christi Dlxiii., usque ad ann. Mcc. ab Hibernis continuò administratum extitisse.

Cap. 5. De Monasterio Campolungensi.
Cap. 6. De Monasterio Himbano.
Cap. 7. De Monasterio Elenensi.
Cap. 8. De Monasterio Kill-Dimensi.
Cap. 9. De Monasterio Kill-Camarthensi.
Cap. 10. De Monasterio Eganensi.
Cap. 11. De Monasterio Alechensi.
Cap. 12. De Monasterio Bothano seu Insulæ Botæ et Kill-Cathanensi.
Cap. 13. De Monasterio Blednano in Ethica.

Dist. 2.—*De Monasteriis pro Hibernis in Anglia fundatis.*

Cap. 1. De Monasterio Glastoniensi.
Cap. 2. De Monasterio Ferramerensi.
Cap. 3. De Monasterio Abban-Dunensi.
Cap. 4. De Monast°. S. Trinitatis Ventano.
Cap. 5. De Monast°. Lindisfarnensi.
Cap. 6. Ostenditur Monasterium Lindisfarnense fuisse primò pro monachis Scotis ex Hibernia oriundis fundatum; ejusque fundatorem S. Aidanum, aliquot ejus successores, discipulos, ac collegas, Scotos ex Hibernia oriundos fuisse.
Cap. 7. De Monasteriis monialium per Angliam ex Lindisfarnensi Congregatione propagatis.
Cap. 8. De Cænobiis Monachorum per Angliam ex Lindisfarnensi Congregatione propagatis.
Cap. 9. De Episcopis, qui ad diversas per Angliam sedes regendas ex Congregatione Lindisfarnensi assumpti sunt.
Cap. 10. De Monast°. Cnoberesburgensi.
Cap. 11. De Monast°. Malmesburiensi.
Cap. 12. De Monast°. Boschanensi.

Dist. 3.—*De Monasteriis per Hibernos sive pro Hibernis in Britannia Armorica fundatis.*

Cap. 1. De Monasteriis Penet-San Sezni, et Guic-Sezni.
Cap. 2. De Monasterio Doulano.
Cap. 3. De Monasteriis Lant-Modez, et Isle-Modez.

DIST. 4.—*De Monasteriis per Hibernos sive pro Hibernis in Gallia fundatis.*

DIST. 5.—*De Monasteriis Scotorum sive Hibernorum in* [*Belgio*].

DIST. 6.—*De Monasteriis Scotorum sive Hibernorum in Lotharingia.*

Cap. 2. De Monast°. S. Hilarij in Vosago.
Cap. 3. De Monast°. Theologico.
Cap. 4. De Monast°. Bello-locensi.
Cap. 5. De Monast°. S. Felicis nunc S. Clementis Metis.
Cap. 6. De Monast°. S. Symphoriani Metis.
Cap. 7. De Monast°. S. Vitoni.

Dist. 7.—*De Monasteriis pro Hibernis in Burgundia fundatis.*

Cap. 1. De Anagranatensi Monasterio.
Cap. 2. De Monast°. Fontanensi.
Cap. 3. De Lutra seu Lutrano S. Deicolæ cœnobio.
Cap. 4. De Archicœnobio Luxoviensi, Galliæ Monasteriorum luce, Monachorum legislatore, ac seminario fæcundissimo.
Cap. 5. De aliquot monachis Hibernis S. Columbani Discipulis.
Cap. 6. De numeroso sanctoque cœtu Monachorum monasterii Luxoviensis.
Cap. 7. De S. Columbani Regula in multis olim Galliæ ac Germaniæ monasteriis observari solita.
Cap. 8. De aliquot Monasteriis sanctimonialium sub regula primò S. Columbani postea S. Benedicti, vel utriusque viventium.
Cap. 9. De aliquot Monasteriis monachorum congregationis Luxoviensis seu in quibus S. Columbani regula consuevit olim observari, eorumque Abbatibus et Monachis aliquot sanctis.
Cap. 10. Brevis Syllabus aliquot Archiepiscoporum Instituti Columbanici, seu qui Regulam S. Columbani primo sæculo ab eâ conditâ professi censentur.
Cap. 11. Catalogus aliquot Episcoporum instituti Columbanici seu qui ejus Regulam primo ab eâ conditâ sæculo, professi sunt.

Dist. 8.—*De Monasteriis per Hibernos et pro Hibernis monachis, in Rhetia, Helvetia, et Suevia, usque ad Danubium fundatis.*

Cap. 1. De S. Hilarij in Urbe Curiensi, Sanctique Martini ibidem cœnobiis.
Cap. 2. De Seckengensi gemino olim cœnobio, nunc verò uno Collegio celeberrino utriusque sexûs.

Cap. 3. De Claronensi olim cœnobio, nunc Parochiali Ecclesia.
Cap. 4. De cœnobio S. Trudperti in Brisgoia.
Cap. 5. De Brigantino D. Aureliæ oratorio.
Cap. 6. De S. Columbæ sive Columbani cœnobio.
Cap. 7. De Desertino cœnobio in Rhetia.
Cap. 8. De S. Galli Monasterio.
Cap. 9. De Campidonensi cœnobio.
Cap. 10. De cœnobio Waltenhovensi, quod et cella S. Magni appellatur.
Cap. 11. De Monasterio Faucensi S. Magni.
Cap. 12. De cœnobio Rhinoviensi.
Cap. 13. De Monte S. Victoris cœnobio.
Cap. 14. De Monasterio Memingensi S. Nicolai.
Cap. 15. De Constantiensi S. Jacobi cœnobio.

DIST. 9.—*De Monasteriis pro Hibernos vel per eos fundatis in Alsatia.*

Cap. 1. De Monastº. S. Hilarij Argentinæ.
Cap 2. De Hagenoensi Asceterio.
Cap. 3. De Monasterio Surburgensi.
Cap. 4. De Ellensi cœnobio, postea S. Arbogasti nuncupato.
Cap. 5. De Monasterio Haselacensi.
Cap. 6. De monastº. S. Thomæ Argentinensi.
Cap. 7. De Hanoviensi S. Michaelis monastº.
Cap. 8. De aliis cœnobiis Archicœnobio Hanoviensi subjectis, octo vel pluribus.
Cap. 9. De S. Ludani Asceterio.
Cap. 10. De Monasterio Andelahensi.

DIST. 10.—*De Monasteriis per Scotos vel pro Scotis seu Hibernis ad sinistram Reni decurrentis ripam ab Alsatiâ usque ad Geldriam fundatis.*

Cap. 1. De Monte seu Monasterio S. Disibodi.
Cap. 2. De Moguntino cœnobio Scotorum.
Cap. 3. De Porzeto cœnobio Aquisgrani.
Cap. 4. De monasterio S. Martini Coloniæ.
Cap. 5. De monasterio S. Pantaleonis Coloniæ.

Cap. 5. De Bobiensi nobilissimo cœnobio.
Cap. 6. De Messulano S. Martini cœnobio.

Dr. Graves observed, that from the notices collected by Mr. Mac Donnell, it might be inferred that Colgan's lost work consisted of two parts. The first, entitled *De Apostolatu Sanctorum Hiberniæ*, appears to have been divided into three books; and a copy of this part in three volumes is mentioned in the Catalogue of Colgan's MSS. (See above, p. 101.) Another copy in one volume is the first of the three volumes referred to by Harris. The index transcribed by Mr. Mac Donnell is plainly that of the remaining portion, viz., the fourth book of the work, which was entitled *De Monasteriis Hibernorum inter exteras gentes.* A copy of this in one volume is mentioned in the Catalogue of Colgan's MSS. The second and third of the volumes referred to by Harris contained, no doubt, another copy. The identity of the contents completely establishes this.

The Rev. Mr. Archbold exhibited an earthen vessel found in the drainage of Lough Fougha, county of Down; and also a small copper vessel, ornamented in enamel, found in the townland of Grange Walls, county of Down.

MONDAY, 26TH JUNE, 1854.

THOMAS ROMNEY ROBINSON, D. D., PRESIDENT, in the Chair.

HIS Excellency the Earl of St. Germans, Lord Lieutenant of Ireland, attended the meeting.

The President communicated an outline of the second part of his paper on the properties of electro-magnets.

The Rev. Dr. Todd exhibited a large collection of gold ornaments recently found in the county of Clare, and made some remarks on the gold ornaments of the ancient Celts, Gauls, and Danes.

The Secretary read a paper by the Rev. Edward Hincks, D. D., on the personal pronouns of the Assyrian and other languages, especially Hebrew :—

"According to the views maintained in this paper, the so-called pronouns of the Hebrew-Assyrian family of languages, belonging to the first and second persons, are of very different classes.

"Some of them consist of a verbal root *an*, to which the real pronouns are attached; which real pronouns are radically the same as the corresponding pronouns of the Indo-European languages. Thus, the Assyrian *anáku*, Hebrew *anoki*, Arabic *aná*, and Coptic *anok*, is literally 'Here I am.' Of the same nature are the Assyrian and Hebrew *atta*, of which the primitive form *anta* is preserved in Arabic; and the feminine and plural forms of the second person.

"Other so-called pronouns consist of a noun with a possessive affix attached to it. Such is the second Hebrew form

of the pronoun of the first person *ani*, literally 'my person.' In this instance the noun has a masculine form. More frequently however, the *t* of the feminine gender is added, and also the *u* which forms the nominative case in Assyrian. Of this nature are the Assyrian *áttua* for *ántua*, and the plural *áttunú*; and also the Coptic *antok*, *antov*, *antos*, *antôten*, &c.

"The form *anakhnu* is supposed to consist of the verbal root, a noun, and the possessive affix for 'our.' It is literally 'Here is our company.'

"The pronouns of the third person are used also for the remote demonstrative; the person spoken of being supposed to be away, while the speaker and the person spoken to are present to one another. The Assyrian forms of these pronouns resemble the Gothic and Sanskrit, as the Hebrew and Arabic forms resemble the Greek and the Zend.

"It is observed that the Assyrian pronouns *anáku* and *attá* have the precise forms of the corresponding persons of a tense of the verb, which denotes state, or permanent or habitual action. The forms of this tense belonging to the third person, on the contrary, do not terminate with the pronouns of that person, or in the same manner with them."

The Rev. Chas. Graves, D. D., read a paper on the principles which regulate the interchange of symbols in certain symbolic equations.

Sir W. R. Hamilton read a paper on some extensions of quaternions:—

"Besides some general remarks on associative polynomes, and on some extensions of the modular property, Sir W. R. Hamilton remarked that if, in the quadrinominal expression

$$Q = w + \iota x + \kappa y + \lambda z,$$

the laws of the symbols $\iota\kappa\lambda$ be determined by the following formula of vector-multiplication,

$$(A) \ldots (\iota x + \kappa y + \lambda z)(\iota x' + \kappa y' + \lambda z') =$$
$$\begin{aligned} & (m_1^2 - l_2 l_3)\,xx' + (l_1 m_1 - m_2 m_3)(yz' + zy') \\ & + (m_2^2 - l_3 l_1)\,yy' + (l_2 m_2 - m_3 m_1)(zx' + xz') \\ & + (m_3^2 - l_1 l_2)\,zz' + (l_3 m_3 - m_1 m_2)(xy' + yx') \\ & + (\iota l_1 + \kappa m_3 + \lambda m_2)(yz' - zy') \\ & + (\kappa l_2 + \lambda m_1 + \iota m_3)(zx' - xz') \\ & + (\lambda l_3 + \iota m_2 + \kappa m_1)(xy' - yx'), \end{aligned}$$

then this expression, which he proposes to call a QUADRINOME, has many properties (associative, modular, and others), analogous to the quaternions ; which latter are indeed only that *case* of such quadrinomes, for which,

$$l_1 = l_2 = l_3 = 1,$$
$$m_1 = m_2 = m_3 = 0,$$
$$\iota = i,\ \kappa = j,\ \lambda = k.$$

He has, however, found another distinct sort of associative quadrinomial expression, which has also several analogous properties, and for which he suggests the name of TETRADS ; the product of two vectors being in it,

$$(B) \ldots (lx + my + nz)(lx' + my' + nz')$$
$$+(\kappa n - \lambda m)(yz' - zy') + (\lambda l - \iota n)(zx' - xz')$$
$$+ (\iota m - \kappa l)(xy' - yx').$$

Dr. Allman communicated the results of some observations he had just made on *Aphanizomenon Flos-aquæ*. This minute alga had begun about three weeks previously to make its appearance in great abundance in the large pond of the Zoological Gardens. The best account we possess of the plant is in an excellent paper on the *Nostochineæ*, by Mr. Ralfs ;* but as the specimens from which Mr. Ralfs's description was drawn up were not in a recent state, some important points of structure have necessarily escaped him.

A. Flos-aquæ shows itself in the form of little fusiform fasci-

* On the *Nostochineæ*. By John Ralfs, M. R. C. S., Ann. and Mag. of Nat. Hist. May, 1850.

culi, of a pea-green colour, which are most frequently seen united to one another in larger bundles. This union of the primary fasciculi into secondary ones is not permanent, and under certain circumstances very imperfectly understood, but, in some cases, depending perhaps on meteorological conditions, the secondary fasciculi become broken up into primary ones, or, at least, into less complicated bundles, and the plant, which had previously lain upon the surface of the pond in an extensive stratum, becomes nearly uniformly diffused through the water. A return of the former conditions will again cause the union of the simpler fasciculi into more complex ones; and the re-accumulation of the plant in masses on the surface.

The primary fasciculi are composed of straight filaments, which are about $\frac{1}{3000}$th of an inch in diameter, and possess the three kinds of cells characteristic of the Nostochineæ, namely, the *ordinary cells*, the *heterocysts*, and the *sporangia*.

The ordinary cells vary much in length in different filaments, and even in the same filament, and not unfrequently they present evident transverse striæ, which doubtless indicate the commencement of division; the endochrome is in the form of minute oval or irregular masses. Under the action of iodine the contents of the cells assume a dark-brown colour, and separating from the walls contract towards the centre of the cell, where they appear bounded by a very definite outline (primordial utricle). The entire filament appears to be surrounded by an indistinct gelatinous (?) sheath.

When the aphanizomenon first showed itself in the pond, the heterocysts were abundant; but no sporangia could be detected. The heterocysts are in the form of short cylinders with rounded extremities, and with bluish-green contents, which scarcely ever present any trace of granular structure. Under the action of iodine the following structures may be seen in the heterocyst:—1. The endochrome contracted towards the centre of the cell, and presenting a well-defined boundary. 2. External to this, a delicate cell-wall separated from the con-

tracted endochrome by a transparent interval, and frequently presenting in its interior, at each extremity, a minute nucleus-like body, with strong refractive powers. 3. An external very delicate, but well-defined transparent investment, which is probably continuous with the general gelatinous (?) investment of the filament.

At first, no other kind of cell beyond those now described could be detected in the filaments, but in specimens gathered somewhat later many filaments presented in some part of their course a long cylindrical and slightly dilated cell, generally about two or three times the length of the heterocysts; occasionally a single filament presented two such cells. They correspond to the cells named sporangia in the other Nostochineæ; their contents are always minutely granular, and under the action of iodine contract towards the centre, and then present a very definite boundary, in which a double outline can sometimes be distinctly seen ; while, external to this, and separated from it by a clear space, a colourless investing membrane has become very obvious; but the second investment, so evident in the heterocysts, could not here be satisfactorily demonstrated: the little spherical body visible at each extremity of the cell of the heterocyst could not be seen in the sporangium. Filaments bearing sporangia were accompanied by those bearing heterocysts, but whether the two kinds of cells ever coexisted in the same filament was not manifest.

That the sporangia are not simply enlarged cells, but the result of the union of several ordinary cells, is evident. The author has succeeded in observing them in intermediate stages of formation, in which the endochrome of a group of ordinary cells had already begun to assume the minutely granular condition of that of the sporangium, the septa being, at the same time, evidently in process of disappearing.

Aphanizomenon Flos-aquæ, after the death of the plant, is eminently sensitive to the action of light. Specimens dried on

paper in the shade are of a dull yellowish green; but if these be now exposed to the direct rays of the sun, for about ten minutes, they will be found to have assumed a bright bluish green, which they do not again lose.

During decomposition in water a fluid is produced, which is of a claret red under reflected light, but of a fine grass-green when viewed by transmitted light.

Dr. Allman also read a notice of a species of *Peridinea*, which had just shown itself in such inconceivable multitudes as to give rise to a peculiar coloration of some of the ponds in the Phœnix Park. During the last three weeks a spectator on the banks of the large ponds in the Park must have been struck by a brown colour assumed by the water. This colour was sometimes uniformly diffused through the water; at other times it appeared as dense clouds, varying from a few square yards to upwards of 100 in extent.

A microscopic examination of the water proved the brown colour to be entirely due to the presence of a minute organism, which the author preferred referring to the genus *Peridinea*, Ehr., rather than constructing for it a new one, though it does not exactly agree with any published generic description.

It is about the $\frac{1}{1000}$th of an inch in diameter, and approaches in form to a sphere divided by a deep annular furrow into two hemispheres, on one of which is situated another furrow, springing vertically from the annular furrow, and terminating at the pole. The author viewed the organism under consideration as essentially a solitary cell; it encloses reddish-brown granular contents, and a large, well-defined central nucleus. In the midst of the contents are numerous clear spaces, of various sizes, which, however, appear to be oil-drops rather than true vacuolæ.

In most instances a deeper-coloured ocelliform spot was evident near the polar extremity of the vertical furrow.

It is eminently locomotive, swimming with great activity by the aid of a flagelliform appendage, which springs from the vertical furrow near the point of junction with the other, and of very minute vibratile cilia, which seem distributed over the surface, and not confined to the furrows, as maintained by Ehrenberg, in the species of Peridineæ described by him.

Before death, or, perhaps, when only passing from a motile to a quiescent state, the contents contract towards the centre, and then an external transparent and perfectly colourless vesicle becomes visible, while the flagellum and cilia disappear. The contracted contents present a very definite and generally spherical boundary, and are evidently included in a distinct cell; the resemblance of this internal cell to the primordial utrical, and that of the external investing vesicle to the cellulose wall of the vegetable cell, are too obvious to be overlooked, though the iodine and sulphuric acid test failed in indicating the presence of cellulose. The external investing vesicle is non-contractile; under pressure it is easily ruptured, and the minutely granular contents, mixed with large oil-drops (?), escape upon the stage of the microscope. The nucleus is then easily isolated; it is of an irregular, oval form, quite colourless, and marked on its surface with curved striæ.

Multiplication is effected by transverse division, which takes place parallel to the annular furrow, and in the unfurrowed hemisphere. This process appears to be invariably preceded by a division of the nucleus, and the author had succeeded in isolating nuclei, presenting almost every stage of transverse fission.

Believing the species now described to be new, the author named it *P. uberrima*.

[Since the communication of the above facts to the Academy, the coloration of the ponds has much increased in intensity. On the 9th of July the author again visited them. The colour in some parts was then of so deep a brown, that a

white disc, half an inch in diameter, became invisible when plunged to a depth of from 3 to 6 inches, while a copious exit stream, which constantly flowed away from one of the ponds, presented the same deep-brown tint.]

Rev. H. Lloyd, D. D., read a paper on the meteorology of Ireland, in reference to the tracks of storms in Ireland, so far as the law of their distribution has been determined in Ireland, by means of the simultaneous observations of 1851.

Mr. D. Moore read a notice of the vine disease in Ireland:—

"It is a remarkable fact, that two diseases bearing much similarity in appearance, and producing equally fatal effects on their victims, both previously unknown, should have occurred in Europe during the same year, and that they should have attacked two species of plants of more importance to the inhabitants of these countries, than, perhaps, any other two under cultivation, namely, the potato and vine.

"So far as I can learn, they first appeared in England during the summer of 1845, after which they seem to have travelled, for some time, at least, in opposite directions, the potato disease from the Continent to England, and the vine disease from England to the Continent. It was in a grapery near Margate, in Kent, that the mildew first showed on the vine, and from thence it spread southward. It does not, however, appear that the vintage in France was seriously affected before 1848, when the disease began to create alarm among the vine-growers in some parts of that country; but, after that period, its spread was rapid both south and north.

"In 1851, we hear of it being at Genoa, Naples, and onwards to Portugal; thence to Madeira and Greece, and now all the vine-producing countries of southern Europe are said to be more or less affected. In England, it continued among

the graperies, in the southern counties, for some time after it appeared, but gradually spread to the north and west.

"The first opportunity I had of seeing it was in a grapery near Manchester, in 1851, where it occurred that summer.

"Since that period I have been expecting to hear of it in Ireland, but am not aware that it made its appearance before last year, when it occurred slightly in several places. My attention was first drawn to it by Mr. Smith, his Excellency's gardener, at the Viceregal Gardens, who stated that something was destroying his grapes in one of the graperies, which we soon found to be a mild phase of the prevalent disease. This year the same house has been again attacked with more virulence, and also the one next it in the same range.

"I have, too, observed it on a vine growing in one of the plant-houses in the Botanic Gardens; and at Merrion Nursery the vines in one of the vineries have been so much affected, as to render their being cut down altogether necessary.

"Such is a brief sketch of the progress of this malady, and I shall now make a few observations on its ordinary appearance and results. As in the potato disease, a minute parasitical fungus is always present, preying on the parts affected; but whether the parasite be the cause of the disease, or consequent upon it, is still a disputed question, which I am unable to throw any further light on. I may, however, state, that most observers in this country incline to what is called the fungal theory, in considering the parasite the cause, especially the Rev. Mr. Berkley, whose knowledge of that tribe of plants is not surpassed by any other European botanist.

"On the other hand, some of the ablest observers in France, who have studied the subject thoroughly, including Dr. Léveillé, and Monsieur Decaisne, consider the fungus to be developed after the tissue of the plant is become diseased, and, therefore, the consequence only.

"This destructive parasite, which I believe to cause the

disease, belongs to the tribe of fungi called Muscedines, which contains the common blue and white moulds, that are everywhere so common, preying on decaying substances, that they have been called nature's scavengers. But there are some of the species which only feed on living vegetable tissue, such as the peach and rose mildews, *Oidium erysiphoides*, and *Oidium leucoconium*, and it is among these the egg mildew of the vine is found. The species was not known to botanists before 1845, when it was first noticed by Mr. Tucker, gardener to a Mr. Salter, near Ramsgate, after whom Mr. Berkley named it *Oidium Tuckeri*. It appears on the leaves and young shoots of the vines, as well as on the berries themselves, marking the former with white, mealy, circumscribed spots in the early stage, and, in a more advanced state, becomes generally diffused over both. When viewed through a good microscope, it is found to consist of slender, branched, articulate threads, which spread over the surface of the spots, and have been seen among the cellular tissue of the leaf, under the epidermis, pushing up the fertile, erect, simple filaments, which bear the reproductive spores at their upper extremities, through the stomates of the leaf, in a similar manner to the potato mould. The effects are rapid: a short time after it appears, pale marks begin to show on the leaves, which gradually enlarge and become dry and brown as if frayed, which is the case with the vines at the Viceregal Garden at present.

"As the berries advance, black depressed spots appear on them, as if they had been injured by being struck against each other, or with a rod. The spots spread, and the berry gets soft and putrid; but if any of the branches on the bunch have been attacked, all the berries on that branch turn brown and soft, and sometimes the branch altogether.

"The appearance of the vine at the Botanic Garden is somewhat different—the berries have become dry, with cracks over the surface, which seems to be the most general state of the disease.

" In this hasty communication I shall only further mention what has been stated to be an effectual remedy in the English graperies, when applied in time, namely, flowers of sulphur, either by themselves, or mixed with lime-water. The pounded mineral has been scattered over all parts of the vines, both in a dry state, and in a state of suspension in water. In the former case, it is blown through a machine called a sulphurator, something in the way of a common bellows; and in the latter, it is washed on with the ordinary garden syringe. All the best practical observers state that in either way it kills the fungus, and arrests the disease. The same remedy has long been understood and applied by horticulturists to destroy the mildew on peach trees, as it does, and the disease stops, which fact goes a considerable way in proving the fungus to be the cause, and not the consequence."

Rev. Dr. Todd then presented a model of an ancient megalithic monument, in the county of Sligo, called Leacht-con-mic-rois, situated in the "Deer Park" of the Right Hon. John Wynne.

George Petrie, LL. D., made some remarks on the monuments of a similar kind found in the county of Sligo.

The President announced the close of the Session, and congratulated the Academy on their new Library and Museum, which were opened this evening.

MONDAY, NOVEMBER 13TH, 1854.

LIEUT.-COL. LARCOM, F. R. S., VICE-PRESIDENT, in the Chair.

THE Secretary read a paper by the Rev. Edward Hincks, D. D., on the Chronology of the Twenty-sixth Egyptian Dynasty, and of the commencement of the Twenty-seventh:—

The paper is first occupied with the period between the last year of Amasis and the first of Darius. Previous to the author's paper on the Egyptian Stèle (read on the 28th of June, 1841), all modern writers on the subject estimated this interval at three or four years. In that paper he showed that it must have contained six years; in this estimate he has been followed by Lepsius and Bunsen; he now contends that the true interval was seven years. The arguments by which he was led to make it six were two: the first was the inscription on the Cosseir Road, in which (as he interpreted it) a person named is stated to have held office for six years of Cambyses, thirty-six of Darius, and twelve of Xerxes. It is not likely, however, that Cambyses would have appointed a person to office in a remote district till some time after his conquest of Egypt; and before this the son of Amasis reigned six months, so that another year should probably be added. The other argument used in 1841 was the testimony of Africanus, whose text, unquestionably corrupt as it stands, could be made to express a consistent meaning by the single change of ε to θ; the uncial forms of which in MSS., shortly after the age of Africanus, are easily confounded. The meaning would be, according to this reading, "Cambyses reigned over his own kingdom of Persia nine years, and over Egypt six." The propriety of the entire reign in Persia being stated, as well as the portion of it during which he ruled Egypt, appears from the fact, recently discovered by Lepsius, that the years of Cam-

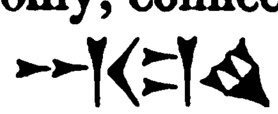
byses in Egyptian records are dated from the death of Cyrus. That the year which preceded the first of Darius was called the ninth of Cambyses appears from a stèle commemorating an Apis, the successor of the one who was killed by Cambyses. He was born in the fifth year of Cambyses, lived eight years, and died in the fourth year of Darius: which must, therefore, have been that which would have been the thirteenth of Cambyses. The difficulty arising from there being only eight years given to Cambyses in the Canon appears, at first sight, great; but the writer conceives that he has effectually removed it. It is proved from the Assyrian monuments, that what was called the first year of a king in Assyria and Babylonia was the year after that in which his predecessor died. On the other hand, Lepsius has shown that in Egypt, the year in which his predecessor died was counted as the first year of the new monarch. What was at its beginning the sixteenth of Nechao became before its close the first of Psammitichus II. If, therefore, Cambyses succeeded Cyrus in the course of 530 B.C., the Egyptians would count the year 522, near the close of which he died, as his ninth year; while the Babylonians would reckon it as only his eighth. The accession of the Magian is shown to have taken place about two months before the end of the Egyptian year; and the next year would be the first of Darius, both in Egypt, because it was that in which he began to reign, and in Asia, because it was that which began next after the death of Cambyses. That Cambyses conquered Egypt in his third year, according to Egyptian computation—this being the year next following the forty-fourth of Amasis—has been proved by Lepsius; but this year is, by what has just been proved, 528 B.C., or A. NAB. 220.

It follows from this that the first of Amasis was A. N. 176; of Apries, A. N. 157; of Psammitichus II., A. N. 151; of Nechao II., A. N. 136; and of Psammitichus I., A. N. 82. Before him, Africanus and Eusebius agree as to the names of three kings, occupying twenty-one years: the names of whom, how-

ever, have not been found on the Egyptian monuments. It is first shown from Assyrian and Jewish synchronisms relating to the reigns of Shebek and Tirhaka, that an interval, not very different from what is assigned to these three reigns, must have elapsed between the reigns of Tirhaka and Psammitichus I. The omission of these names from the monuments is then attempted to be explained. It was first shown, by a genealogy of the Saite dynasty, that none of its kings, with the exception of the last, was descended from Queen Amenirtas, who, it was maintained, was the representative of the ancient Pharaohs. Five kings, however, in succession married into this family; the queen being, in three instances, half-sister to the king. By these marriages they strengthened their title to the crown, which otherwise was only possession by conquest. It was then argued that, as the Assyrian inscriptions spoke of "Kings of Egypt," as well as "the King of Meroe," Tirhaka, who, however, was monumentally "King of Upper and Lower Egypt;" and as the story of the dodecarchy, as given by Herodotus, must have had some foundation—though it was not correctly given—the following view was likely to be a correct one:—A dodecarchy of Egyptian chiefs (*hiks*) existed under the Ethiopian monarchs. On the death of Tirhaka some of them, including Stephinates, the dodecarch of Sais, assumed royal titles; subsequently *Amenirtas*, the "Ammeris, the Ethiopian" of Eusebius, who was probably a daughter of Tirhaka, claimed supreme authority over these dodecarchs, and established it to a great extent. The termination of the dodecarchy, by Psammitichus obtaining the sole power, may have happened in some such way as Herodotus describes; this, however, could not have been previous to his fifty-four years' reign, as Herodotus states. He ruled, from his father's death, as dodecarch and king, only fifty-four years in all. If this view be a correct one, it is not necessary to suppose that any monuments of any Saite prince before Psammitichus I. existed. Dr. Hincks, however, supposes that a stèle in the Louvre, in which

a king is represented whose prænomen is *Ra-men-kheper*—the name having been hammered out—commemorated Stephinates, and that it was defaced by order of Queen Amenirtas. He thinks, also, that the name Stephinates was a Greek corruption of *Tuf-Net*, "Neith is his breath:" which, he contends, was the proper pronunciation of the name of a person of whom there are naophorous statues at London and Paris; as there are of two of his sons at London and Rome, and of a grandson at London. From the inscriptions on these five statues, he concludes that this person must have been born in the latter part of the reign of Psammitichus I.: which would allow of his grandfather, from whom he inherited his name, being born under Stephinates.

The Secretary also read a paper, by the same author, on Assyrian Mythology.

This paper contains an enumeration of the Assyrian deities in the order in which their names occur on the obelisk in the Museum. The above gods are first mentioned, and, in connexion with them, some of their principal attributes, and certain mystic numbers annexed to their names on a tablet in the British Museum. They are—*Assur*, king of the gods, who has no number; *Anu*, 60; *Bil*, 50; the sea-god, whose name is supposed to be *Dagan*, 40; *Tsin*, 30; *Bin*, 6; *Shamas*, the sun, 20; *Marduk* (lost); *Bar*, "the son of the god, 50," the principal war-god (lost); another war-god, supposed to be *Nirgal*, 12; and *Nabiu*, 10. The goddesses are then considered, about whom there is a difficulty. Three goddesses are mentioned in the Khorsabad inscriptions as holding the chief rank; though "the great wives" of several gods are mentioned also, who must be different from them. The two first of these are alone mentioned on the obelisk; while the tablet containing the numbers gives the third only, connecting her with the number 15. Her monogram is . On a cylinder of Esarhaddon in the Museum two goddesses are mentioned:

the 15 of Nineveh, and the 15 of Arbela. The former of these must be Ishtar, always called the mistress of Nineveh; and the latter is presumed to be the goddess named on the tablet, who presided over childbirth. Of the goddesses named on the obelisk, the first is stated to have been named *Biltu* and *Jarpanitu*. She was the wife of *Bil;* and is called "mother of the gods," as *Bil* is called their father. She is presumed to have been connected with the planet Venus, as *Ishtar* is certainly the moon. The name of *Ishtar* occurs last on the obelisk; she was regarded as the wife of Assur, and mistress of Nineveh. Her name is used as an appellative for "goddess." On the figure of a lion in the British Museum is a long inscription in honour of the goddess of war, to whom it is dedicated. She may have been the same as *Jarpanitu*.

Mr. Haughton communicated an account of some experiments made by him during the last summer, on the reflexion of plane polarized light from the surface of transparent bodies. These experiments were made with sunlight, and repeatedly verified. The new laws established by the experiments are the following:—

First Law.—If light polarized in any azimuth be incident on a transparent surface, and the angle of incidence be increased from 0° to 90°, the reflected elliptically polarized light has a minimum ratio of axes at the principal incidence, and is plane polarized at 0° and 90°; or the ratio of axes is infinity.

Second Law.—That as the azimuth of the incident polarization approaches a certain limit, which Mr. Haughton calls the circular limit, the minimum ratio of axes diminishes.

Third Law.—That when the azimuth of the incident polarization is equal to the circular limit, the ratio of axes of reflected light is unity; or the reflected light is circularly polarized.

Fourth Law.—That when the azimuth of incident polarization exceeds the circular limit, and recedes from it, the ratio of axes again increases from unity.

Fifth Law.—That when the azimuth is less than the circular limit, the major axis moves always in the same direction, passing through the plane of incidence, when the incidence is the principal incidence.

Sixth Law.—That when the azimuth is greater than the circular limit, the axis major moves towards the plane of incidence, reaches a minimum, and turns back,—passing through the plane perpendicular to plane of incidence at principal incidence; and as the angle of incidence increases, the major axis describes a minimum on the other side of perpendicular, and returns to a position at 90°, making an equal angle with that at which it set out, and at the other side.

Rev. Mr. Jellett made some observations on this communication, pointing out the great value of Mr. Haughton's experiments.

The following antiquities were presented by Joseph Huband Smith, Esq.:—

1. Stone urn, found in a tumulus at Dunadry, county of Antrim, in 1837.

2. Two fragments of rings, one of glass, the other of jet, found in the same place.

3. Portion of large stone hammer, found in Island Magee, county of Antrim.

4. Ball of green glass, found in a bog near Clogher, county of Tyrone.

5. Small globular glass bottle, found at Slievegullion, county of Armagh.

6. Fourteen ancient glass beads, found in the county of Antrim.

7. Double glass bead, purple.

8. Silver globular bead, ornamented.

9. Lozenge-shaped silver reliquary, ornamented in niello, containing a ring of plaited rush and a piece of linen cloth, found in a small artificial cave at Straidcalye, near Glenarm, county of Antrim, in 1839.

10. Bronze spear-head, highly ornamented.

11. Bronze pin, with lateral ornamented head, found near Clogher, county of Tyrone.

12. Circular ecclesiastical seal.

13. Small leaden bulla, with the figure of the Virgin on the one side, a crucifix on the other, and the date 1728.

14. Stone bowl of basalt, found near Gorey, in the county of Wexford.

15. Square stone, with heraldic shield, containing the armorial bearings of the Cheevers family, from the church of Cheeverstown, in the county of Meath.

16. Triangular monumental stone of John Joel Josse, Kettle-drummer of Charles II., containing the arms of Ireland (three harps, two and one), and the date 1678, found in the graveyard of St. Andrew's church, Dublin.

17. MS. containing Irish Fenian tales, from Fintona, in the county of Tyrone.

18. Two specimens of melted stone, from a vitrified fort near Banagher, in the county of Derry.

The Secretary presented, on the part of William Anderson, Esq., a wooden candlestick, found in a bog at a considerable depth by Mr. John Byrne, on the lands of Lower Lyrane, county of Kerry, the property of the Marquess of Lansdowne.

November 30th, 1854. (Stated Meeting.)

LIEUT.-COL. LARCOM, F.R.S., Vice-President, in the Chair.

The Secretary of Council read the following recommendations of the Council, adopted at their meeting held on 26th June last:—

"1. That one Member of each Committee shall go off each year, in addition to any vacancies which may be caused by death, resignation, or non-attendance.

"2. That the senior Members of each Committee, with the exception of the Secretary of the Academy, the Secretary of the Council, the Treasurer, the Librarian, and the Vice-Presidents, go off in each year.

"3. That in preparing the list before each election, the names of the Members who go off shall be printed in Italics, and the names of those whom the Council recommend to fill their places be printed in capitals."

After some discussion, it was moved by John Anster, LL. D., and seconded by George Petrie, LL.D.,—

"That the opinion of counsel be taken, whether the proposed Resolutions are consistent with the Charter."

A division having been called for, it was found that 19 Members voted for the proposition, and 31 against it; whereupon the Chairman put the first of the above Resolutions recommended by the Council.

It was moved by Sir Robert Kane, and seconded by Aquilla Smith, M. D., and

Resolved,—That this recommendation be amended as follows:—

"That it is expedient that one Member of each Committee be removed in each year, in addition to any vacancies which may be caused by death, resignation, or non-attendance."

The second recommendation of the Council having been read by the Chairman, it was moved by F. J. Sidney, LL.D., and seconded by W. T. Mulvany, Esq., and

Resolved,—"That this recommendation be amended as follows:—'That the Members so to be removed should be the senior Members of each Committee, with the exception of the Secretary of the Academy, the Secretary of the Council, the Treasurer, the Librarian, and the Vice-Presidents.'"

The third recommendation of the Council having been read by the Chairman, it was moved by J. M. Neligan, M.D., and seconded by H. C. Beauchamp, M. D.,—

"That this recommendation be amended by omitting the words, 'and the names of those whom the Council recommend to fill their places be printed in capitals.'"

The Chairman having declared that this amendment was negatived, it was proposed by F. J. Sidney, LL. D., and seconded by Aquilla Smith, M. D., and

Resolved,—"That in the third recommendation, the words 'who go off' be omitted, and the words 'so to be removed' be substituted in their place."

The recommendations of the Council as amended will stand thus:—

"1. That it is expedient that one Member of each Committee be removed in each year, in addition to any vacancies which may be caused by death, resignation, or non-attendance.

"2. That the Members so to be removed should be the senior Member of each Committee, with the exception of the Secretary of the Academy, the Secretary of the Council, the Treasurer, the Librarian, and the Vice-Presidents.

"3. That in preparing the list before each election, the names of the Members so to be removed shall be printed in Italics, and the names of those whom the Council recommend to fill their places be printed in capitals."

NOVEMBER 30TH, 1854. (Stated Meeting.)

LIEUT.-COL. LARCOM, F.R.S., VICE-PRESIDENT, in the Chair.

THE Secretary of Council read the following recommendations of the Council, adopted at their meeting held on 26th June last:—

"1. That one Member of each Committee shall go off each year, in addition to any vacancies which may be caused by death, resignation, or non-attendance.

"2. That the senior Members of each Committee, with the exception of the Secretary of the Academy, the Secretary of the Council, the Treasurer, the Librarian, and the Vice-Presidents, go off in each year.

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"That the opinion of counsel be taken, whether the proposed Resolutions are consistent with the Charter."

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"3. That in preparing the list before each election, the names of the Members so to be removed shall be printed in Italics, and the names of those whom the Council recommend to fill their places be printed in capitals."

MONDAY, DECEMBER 11TH, 1854.

LIEUT.-COL. LARCOM, F.R.S., VICE-PRESIDENT, in the Chair.

THE following account of a series of analyses, instituted to determine the relative quantities of potash and soda in the felspar of the Dublin and Wicklow granite, was read by the Rev. Joseph A. Galbraith, Erasmus Smith's Professor of Natural and Experimental Philosophy in the University of Dublin.

"Granite is a rock which generally consists of three constituents, namely, quartz, mica, and felspar, in varying proportions. The first of these, quartz or silex, is a mineral of invariable composition; the second, mica, is a mineral of complex constitution, admitting of considerable varieties both in its chemical composition and in its physical properties. In some granites it is replaced either wholly or in part by hornblende; as, for instance, in the syenite of Egypt, and the granites of the county of Galway. In some by talc, as in the Protogene of Mont Blanc, and in parts of Cornwall; and occasionally by the remarkable hydrated mineral chlorite, as in the granite rocks in the vicinity of Liskeard. The third constituent, felspar, is a mineral of very definite composition, admitting of no important chemical variety, except in its alkaline constituents. The nature and extent of this variety will be best understood by comparing together the following theoretical analyses, which are extreme cases:—

Composition of Typical Orthose, or Potash Felspar.		Composition of Typical Albite, or Soda-Felspar.	
Silex,	64·81	Silex,	68·74
Alumina,	18·38	Alumina,	19·50
Potash,	16·81	Soda,	11·76
	100·00		100·00

One is calculated on the hypothesis that the mineral contains no other alkali than potash, the other on the hypothesis that it contains soda only.

"The fact is, that we rarely, if ever, find a felspar whose composition coincides altogether with either of these calculated analyses, both the alkalies being, we may say, always present, but in almost every case (with a few exceptions specified in the standard works on mineralogy) one of them is found to preponderate greatly over the other, and accordingly the name orthose, or potash felspar, has been generally assigned to those specimens whose chemical character is defined by a great excess of potash, while the name albite, or soda felspar, has been given to those in which soda exists in great excess. There are other distinctions founded on crystallographic form, which at present I purposely abstain from dwelling upon, my present object being to lay before the Academy the results of the chemical examinations I have made of this important constituent of our granite rocks.

"The ordinary felspar occurring in granite is orthose or potash felspar, and in those cases in which this mineral is replaced or accompanied by albite, the granite is designated albitic. In Ireland we have a very interesting case of this description in the granite of the Mourne mountains. And accordingly, we frequently find it cited both by English and foreign writers on geology as a typical locality. The granite district which stretches in a south-westerly direction from Williamstown, in the county of Dublin, through the county of Wicklow, to Poull Mounty, in the neighbourhood of New Ross, has been, up to a very late period, supposed to furnish that variety of felspar only which is called orthose or potash-felspar. Any statement, therefore, to the contrary, if made on competent authority, must naturally attract attention; and any amount of pains or trouble may be said to be well expended if we can arrive at the determination of a question of such high interest to the geological inquirer.

"A statement of this nature, made by a Member of this Academy about two years ago, first drew my attention to the subject. Many circumstances have contributed to prevent me from carrying on the investigation as rapidly as I could have wished. Nor have I even yet completed the series which I originally projected, as I had determined not to rest satisfied until I had fairly examined the whole range of the Dublin and Wicklow mountains from Killiney to New Ross. Although I have not completed my series, I have, notwithstanding, examined that portion of the district which extends from the quarries of Dalkey to the mountain of Lug-na-quilla, and which, so far as Sir Robert Kane's statement is concerned, is the most important; and accordingly, I do not hesitate to lay before the Academy, as a first contribution towards a complete chemical investigation of this subject, the results of seven analyses of felspars taken from different localities in these mountains, and of founding upon them my dissent from the statement made by Sir Robert Kane, viz., 'that the felspar of our Dublin granites is upon the whole a soda or albitic felspar.

"These words occur in the concluding statement of a communication made to the Academy in the month of January, 1853, in which he 'brought under the notice of the Academy the results of the analysis of the waters of the streams which descend from the side of the Dublin mountains, such as the Three Rock Mountain, with a view to illustrate the process of decomposition of the granite masses of these rocks, and the conversion of the felspathic elements into clays adapted to ceramic manufactures.'

"In this paper we find two analyses, one that of a water taken from a stream running down the side of the Three Rock Mountain at a place called Ticknock; the other of a water collected from a hole in a quarry, excavated for the purpose of cutting out the substance so well known in this city as freestone. From the residues of both these waters after evaporation, the soda greatly preponderates over the potash, in the

former in the ratio of 6 : 1; in the latter in the ratio of 10 : 1. From these facts he drawn an inference which, from its importance, I shall quote from the Proceedings in his own words:—

"'The analysis of these waters have placed in view another fact of much interest in regard to the geognostic character of the granite of the Dublin mountains. In the water there were found both potash and soda, but the latter in very great excess. This indicates that the felspar of our Dublin granite is upon the whole a soda or albitic felspar, although in particular spots orthose, or potash felspar, may be found. The fact has been also verified by a great number of analyses of specimens of granites from various parts of the great mass which extends from Dublin into the county of Wicklow. In all the analyses made, which included both ordinary granites and elvan or granite porphyries, both potash and soda were present, and the latter almost always so preponderant as to lead to the conclusion that the potash should in most cases be considered to belong to the mica which the granite contained, and that the felspar was almost exclusively an albitic or soda felspar, containing only in some cases a small quantity of replacing potash.'—*Proceedings*, vol. v. p. 351, January 10, 1853.

"A statement so precise as this, and at the same time so novel, naturally called forth discussion; and accordingly I find that Dr. Apjohn, who was present when the communication was made, expressed surprise at the fact, which he then learned for the first time, namely, that potash was either absent from the Dublin felspar, or, at most, only casually present, and then only in insignificant quantities; that Sir Robert Kane's communication stated as a principal fact that which was wholly contrary to his experience. Dr. Apjohn considered this question one of such importance that he made it the subject of a communication, which he shortly after laid before the Academy, in which he brought forward a number of facts

which appeared to him irreconcilable with the conclusion arrived at by Sir Robert Kane, namely, that in the granite of the Dublin and Wicklow granites soda existed in great excess, and that only in some cases they contain a small quantity of replacing potash; and in which he stated his opinion that we could not rest such a conclusion on an argument which appeared to him too circuitous, especially when the investigation might be conducted in a simpler and more direct manner than that pursued by Sir Robert Kane, namely, the analysis of surface water, and the examination of rock specimens taken from the district; and that he did not think that mineralogists would feel themselves safe in adopting Sir Robert Kane's conclusions, until it was supported by the results of experiments made directly on the felspars themselves.

"Feeling the importance of this suggestion, it occurred to me that good service might be done to the sciences, both of mineralogy and geology, if I were to undertake the chemical examination of the minerals whose character was called in question, in order, if possible, to arrive at the determination of such an interesting question. And that I might not fall on these 'particular spots where orthose or potash-felspar was to be found,' I cast my eye over the map of Dublin and its adjacent county, and selected a number of localities pretty evenly distributed over the range commencing at Dalkey and extending as far as Glenmalur, situated on the flanks of Lugna-quilla, which is about thirty-six miles from Dublin.

"The results of these analyses I beg to lay before you. The distances of the localities from which the specimens were taken may be stated as follows:—

From Dalkey to Three Rock Mountain,	5	miles.
,, Three Rock Mountain to Lough Bray,	5	,,
,, Lough Bray to Lough Dan,	8	,,
,, Lough Dan to Glenmacanass,	2	,,
,, Glenmacanass to Glendalough,	5	,,
,, Glendalough to Glenmalur,	2	,,

DALKEY QUARRIES.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	64·00	1·412		4·01
Alumina,	18·11	0·352		1·00
Magnesia,	0·57	0·028	0·396	1·13
Lime,	Trace,	0·000		
Potash,	12·73	0·271		
Soda,	3·00	0·097		
Loss by ignition,	0·55			
	98·96			

Sp. gr. = 2·540.

THREE-ROCK MOUNTAIN.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	65·40	1·444		4·19
Alumina,	17·71	0·344		1·00
Magnesia,	1·77	0·088	0·420	1·22
Lime,	Trace,	0·000		
Potash,	10·68	0·227		
Soda,	3·26	0·105		
Loss by ignition,	0·69			
	99·51			

Sp. gr. = 2·562.

LOUGH BRAY.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	65·44	1·444		4·04
Alumina,	18·36	0·357		1·00
Magnesia,	0·00	0·000	0·388	1·08
Lime,	0·80	0·038		
Potash,	12·34	0·262		
Soda,	2·73	0·088		
Loss by ignition,	0·52			
	100·19			

Sp. gr. = 2·554.

LOUGH DAN.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	65·05	1·436		4·16
Alumina,	17·72	0·345		1·00
Magnesia,	Trace,	0·000	0·381	1·10
Lime,	0·23	0·008		
Potash,	13·42	0·285		
Soda,	2·75	0·088		
Loss by ignition,	0·36			
	99·53			

Sp. gr. = 2·559.

GLENMACANASS.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	64·19	1·417		3·96
Alumina,	18·39	0·358		1·00
Magnesia,	0·34	0·017	0·379	1·05
Lime,	0·70	0·025		
Potash,	11·39	0·242		
Soda,	2·95	0·095		
Loss by ignition,	0·58			
	98·54			

Sp. gr. = 2·553.

GLENDALOUGH.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	63·60	1·404		3·83
Alumina,	18·84	0·366		1·00
Magnesia,	0·40	0·020	0·385	1·05
Lime,	Trace,	0·000		
Potash,	14·33	0·305		
Soda,	1·92	0·060		
Loss by ignition,	0·60			
	99·69			

Sp. gr. = 2·453.

GLENMALUR.

	Per Cent.	Atomic Quotients.		Proportionals.
Silex,	64·48	1·423		3·84
Alumina,	19·04	0·370		1·00
Magnesia,	1·02	0·051	0·364	0·98
Lime,	Trace,	0·000		
Potash,	10·74	0·228		
Soda,	2·64	0·085		
Loss by ignition,	0·78			
	98·70			

Sp. gr. = 2·560.

"On examining these analyses, it will be found that not even in a single instance do they deviate from the well-known composition of orthose or potash felspar. The average ratio of potash to soda from these analyses is 9 : 2; the greatest amount of soda present being 3¼ per cent., which is found in the specimen taken from the Three Rock Mountain, which quantity, although relatively great, is less than one-third of the potash in the same specimen.

"We find, from the extract which I have read, that Sir Robert Kane was unwilling to found a statement as to the nature of our granites so important as this on an inference drawn from the analysis of a water taken from the locality; for he affirms that his conclusion is verified by a number of analyses of granite specimens taken from various parts of the range, and that in all these specimens so great was the excess of the soda over the potash, that he felt himself warranted in drawing the conclusion that the potash should, in most cases, be considered as belonging to the mica, and that the felspar was almost exclusively an albitic or soda felspar, containing only in some cases a small quantity of replacing potash.

"On referring to the analyses which I now lay before you, I think I am warranted in the statement, that the felspars of this district are orthose or potash felspar, containing only small quantities of replacing soda.

"On the occasion when Dr. Apjohn made his communication, I find that Sir Robert Kane repeated his statement as to the nature of these granites, together with the grounds on which he rested it. 'The idea,' viz., that the predominant characters of the granite district of Dublin and Wicklow was the presence of soda felspars, 'was founded not merely on the results of the analysis of the waters read at the last meeting, and which in itself he did not consider very important, but was the result of a widely-spread series of observations, which, on another occasion, he hoped to be able to bring before the Academy.'—Vol. v. p. 382, February 28, 1853.

"Feeling, as I do, a great interest in this question, I confess I have for a long time looked forward with some anxiety for the production of these analyses; and I hope I may be allowed, on the part of the Academy, to express the hope, that at no distant day Sir Robert Kane will lay before the Academy what I am sure will be esteemed a most valuable communication. Independently of my wish to arrive at the settlement of a scientific question, I feel some anxiety on the subject for another reason, namely, my utter inability to reconcile Sir Robert Kane's statement, with regard to the results of his rock analyses, with what (at least to my own satisfaction) I think I have succeeded in proving. The granite of Dublin and Wicklow, as I have said, consists of three elements, quartz, mica, and felspar. Of these quartz, as is well known, contains no alkali, and may be therefore dismissed from our consideration. Mica contains both alkalies, but the potash always in great excess. Felspar, the third element, contains, as I have shown, both potash and soda, but the former always in great excess, in the ratio, namely, of 9:2. This being the case, I cannot in any way see how a rock, which is a mixture of these three constituents, should on analysis yield 'both potash and soda; but the latter, viz., soda, almost always so preponderant, as to lead to the conclusion that the potash should, in most cases, be considered to belong to the mica

which the granite contained, and that the felspar was almost exclusively an albitic or soda felspar, containing only in some cases a small quantity of replacing potash."

Rev. Mr. Haughton stated, with reference to Mr. Galbraith's communication, that he had himself made a chemical examination of some specimens of mica from the Wicklow and Dublin granites, with reference to some remarkable differences in their optical properties, and that he had found in these micas, as Sir Robert Kane himself had observed, a preponderance of potash over soda, on an average of about 15 to 2. This result seemed to Mr. Haughton to render very difficult of satisfactory explanation the result of Sir R. Kane's unpublished analyses of granites, in which he found a great preponderance of soda; for if the micas contain potash to soda in the proportion of 15 to 2, and the felspar, as Mr. Galbraith had just demonstrated, contain potash to soda in the proportion of 9 to 2, Mr. Haughton confessed himself unable to understand how a rock made up of such minerals could contain a great preponderance of soda. He quite concurred in Mr. Galbraith's wish, that Sir R. Kane would favour the Academy with his promised analyses.

Dr. Apjohn remarked, that in his opinion Mr. Galbraith's analyses were conclusive as to the relative quantities of potash and soda in the Dublin and Wicklow felspars, and were quite coincident with the opinions which he had himself previously expressed upon this subject. He further observed, that he objected to the use of the terms orthose and albite, as distinguishing between potash and soda felspars, as both alkalies might and did occur in both minerals in varying proportions. The true distinction, in his opinion, between these minerals was crystallographic, the former always occurring in the fifth, and the latter in the sixth system.

Mr. Mallet mentioned a fact which had come under his observation, which confirmed in a remarkable manner the re-

sults of Mr. Galbraith's analyses. Having had occasion to analyze the water of the river Liffey above King's Bridge, in order to ascertain the quantity of alkalies contained in it, he found distinct evidence of the presence of potash, and none whatever of the presence of soda. And as this river takes its rise in the granite platform of the Wicklow hills, and might be said to contain the washings of that district, the presence of potash strongly confirms the opinion maintained by Mr. Galbraith, that the felspar of the Dublin and Wicklow hills was potash felspar.

Mr. Galbraith explained, that he had used the terms orthose and albite in the sense in which Sir R. Kane had used them, although he did not consider it quite exact, as his object was to confine himself exclusively to the consideration of the relative numerical quantities of potash and soda in the Wicklow felspars.

The Rev. Professor Graves continued the reading of his Paper on the principles which regulate the interchange of symbols in certain symbolic equations.

Let π and ρ be two distributive symbols of operation, which combine according to the law expressed by the equation,

$$\rho\pi = \pi\rho + a, \tag{1}$$

a being a constant, or at least a symbol of distributive operation commutative with both π and ρ.

In this fundamental equation, if we change π into ρ and ρ into $-\pi$, it becomes

$$-\pi\rho = -\rho\pi + a,$$

or

$$\rho\pi = \pi\rho + a, \tag{2}$$

the same as before. From this it follows, that in any symbolical equation,

$$\phi(\pi, \rho) = 0, \tag{3}$$

which has been directly deduced from the fundamental equa-

tion (1), without any further assumption as to the nature of the operations denoted by π and ρ, we may change π into ρ, and ρ into $-\pi$; so as at once to form the correlative equation,

$$\phi(\rho, -\pi) = 0; \tag{4}$$

for this latter will be deducible from the primitive, in the form (2), by the same processes, whatever they are, which conduct us from (1) to (3).

The value of this principle must depend upon the extent of its application; and this will be found much wider than might at first sight be supposed. For a symbolical equation of the form (3), which is verified for any subject whatever operated on by its left-hand member, if it be not, in its existing state, identically true, must hold good in consequence of our being able to transform it into one that is identically true by means of the fundamental equation (1), which connects π and ρ. Thus we may regard all useful equations of the form (3) as deductions from the single primitive (1).

Of the general nature of the results which may be deduced from this one very simple equation, and that without the introduction of any fresh hypothesis as to the operation of π and ρ, the following example will give a sufficient idea.

Making $a = 1$, which does not much diminish the generality of our conclusions, we have

$$\begin{aligned} \rho\pi &= \pi\rho + 1, \\ \rho\pi^2 &= \pi\rho\pi + \pi, \\ &= \pi(\pi\rho + 1) + \pi, \\ &= \pi^2\rho + 2\pi. \end{aligned}$$

Again,

$$\begin{aligned} \rho\pi^3 &= \pi^2\rho\pi + 2\pi^2, \\ &= \pi^2(\pi\rho + 1) + 2\pi^2, \\ &= \pi^3\rho + 3\pi^2. \end{aligned}$$

And for n any positive integer we get,

$$\rho\pi^n = \pi^n\rho + n\pi^{n-1}.$$

Again, operating on the equation

$$\rho\pi = \pi\rho + 1,$$

with

$$\pi^{-1}(\ \ )\pi^{-1},$$

we get

$$\rho\pi^{-1} = \pi^{-1}\rho - \pi^{-2};$$

from which we deduce

$$\rho\pi^{-n} = \pi^{-n}\rho - n\pi^{-n-1}.$$

So that the equation

$$\rho\pi^{n} = \pi^{n}\rho + n\pi^{n-1},$$

holds good for any integer value of n.

From this again we infer that

$$\rho\ \psi\pi = \psi\pi\ \rho + \psi'\pi, \tag{5}$$

where $\psi\pi$ represents any function of integral powers of π. And from (5), finally, we can ascend to the more general theorem,

$$\phi\rho\ \psi\pi = \psi\pi\ \phi\rho + \psi'\pi\ \phi'\rho + \frac{1}{1.2}\psi''\pi\ \phi''\rho + \&c. \tag{6}$$

Changing π into ρ, and ρ into $-\pi$, in the last two equations, we obtain the correlative ones,

$$\pi\ \phi\rho = \phi\rho\ \pi - \phi'\rho, \tag{7}$$

$$\psi\pi\ \phi\rho = \phi\rho\ \psi\pi - \phi'\rho\ \psi'\pi + \frac{1}{1.2}\phi''\rho\ \psi''\pi - \&c. \tag{8}$$

In the theorems here given the reader will recognise an extension to the symbols π and ρ of the theorems respecting x and D, stated by Dr. Hargreave at the commencement of his remarkable paper on the Solution of Differential Equations, printed in the Transactions of the Royal Society for 1848. Having obtained the theorems,

$$\phi D\ \psi x = \psi x\ \phi D + \psi' x\ \phi' D + \frac{1}{1.2}\psi'' x\ \phi'' D + \&c., \tag{9}$$

$$\psi x \ \phi D = \phi D \ \psi x - \phi' D \ \psi' x + \frac{1}{1.2} \phi'' D \ \psi'' x - \&c., \qquad (10)$$

separately, Dr. Hargreave observed that the latter might be deduced from the former by changing x into D, and D into $-x$; and on this observed fact he founded the conclusion that, in expressions capable of being reduced to the form (9) or (10), we are at liberty to effect the above-mentioned interchange of symbols.

The preceding investigation enables us to account for the fact just referred to, and to establish on what seems to be its real foundation the validity of the proposed method of deriving formulæ one from the other. If we take $f(x)$ any function of x, we shall have

$$D\,(xfx) = x'xf + fx,$$

or, detaching the subject fx from the operations effected on it, we find that

$$Dx = xD + 1 \qquad (11)$$

is a symbolical equation which holds good whatever subject be operated on by each of its terms. It is, in fact, the fundamental equation which defines the law according to which x and D combine. And as in this equation we may change x into D, and D into $-x$; we may do the same in (9), or in any other equation derived from it.

From this one equation (11) the principal symbolic formulæ of the Differential Calculus can be deduced; and we may, therefore, regard a great part of it as included in that single branch of the Calculus of Operations which refers to the properties of symbols connected by the fundamental equation with which this Paper commences.

But there are other changes of symbols which may be made in formulæ deduced from the equation,

$$\rho\pi = \pi\rho + 1.$$

Since ρ is distributive, we shall have

$$\rho\ f\rho = f\rho\ \rho,$$

and adding these equations together, we get

$$\rho\,(\pi + f\rho) = (\pi + f\rho)\,\rho + 1, \tag{12}$$

an equation still of the same *form* as (1). And, therefore, in any symbolical equation deduced from (1) merely in virtue of its form, we are at liberty to change π into $\pi + f\rho$. Similar reasoning will show that in symbolical formulæ obtained in the same way, we may change ρ into $\rho + f\pi$. As particular cases of this we may observe that in any symbolical equation involving x and D, we are at liberty to change x into $x + fD$, or D into $D + fx$.

Again, if we operate on (5) with $(\psi'\pi)^{-1}$, it becomes

$$(\psi'\pi)^{-1}\rho\,\psi\pi = \psi\pi\,(\psi'\pi)^{-1}\rho + 1,$$

inasmuch as any two functions of π are commutative. Now this again is an equation of the form

$$\rho\pi = \pi\rho + 1,$$

$(\psi'\pi)^{-1}\rho$ being put for ρ, and $\psi\pi$ for π.

It follows then that in any deduction from (1) we may change

$$\left.\begin{array}{l}\rho \text{ into } (\psi'\pi)^{-1}\rho, \\ \text{and} \\ \pi \text{ into } \psi\pi.\end{array}\right\} \tag{13}$$

In like manner, if we operate on (7) with $(\phi'\rho)^{-1}$, it becomes

$$\phi\rho\,(\phi'\rho)^{-1}\pi = (\phi'\rho)^{-1}\pi\,\phi\rho + 1\,;$$

showing that in any deduction from (1) we may change

$$\left.\begin{array}{l}\rho \text{ into } \phi\rho, \\ \text{and} \\ \pi \text{ into } (\phi'\rho)^{-1}\pi.\end{array}\right\} \tag{14}$$

Writing x for π, and D for ρ, we learn from (13) that it is legitimate in symbolical formulæ to change x into ψx, and D

into $(\psi' x)^{-1}D$. This, in fact, reproduces the known rule for the change of the independent variable.

From (14) we conclude that the change of

$$D \text{ into } \phi D,$$

and

$$x \text{ into } (\phi' D)^{-1}\pi,$$

is a legitimate one. The validity of this change has not, we believe, been noticed before. It is unnecessary to adduce any more particular instances of the general law of interchange of symbols which may be established, viz.: If from (1) we can deduce any equation of the form

$$\mathrm{P}\Pi = \Pi\mathrm{P} + 1;$$

when P and Π can be expressed in terms of ρ and π, then, in any symbolical equation derived from (1), we are at liberty to change ρ into P, and π into Π.

Some very important deductions may be made from the equation (1). As a particular case of formula (5), we have

$$\rho e^{\psi\pi} = e^{\psi\pi}\rho + e^{\psi\pi}\psi'\pi,$$

therefore,

$$\rho + \psi'\pi = e^{-\psi\pi}\rho e^{\psi\pi};$$

whence we conclude, that

$$f(\rho + \psi'\pi) = e^{-\psi\pi} f\rho\, e^{\psi\pi}. \tag{15}$$

That is to say, the symbol,

$$e^{-\psi\pi}(\quad)\, e^{\psi\pi},$$

operating on any function of ρ will change it into the corresponding function of $\rho + \psi'\pi$.

Changing π into ρ, and ρ into $-\pi$, we should find

$$f(\pi + \psi'\rho) = e^{\psi\rho} f\pi\, e^{-\psi\rho}, \tag{16}$$

which shows that the symbol,

$$e^{\psi\rho}(\quad)\, e^{-\psi\rho},$$

operating on any function of π will change it into the corresponding function of $\pi + \psi'\rho$.

The substitution of x for π, and D for ρ, in (16), leads to a result which is of considerable value, viz., that

$$e^{\psi D} fx \, e^{-\psi D} = f(x + \psi' D).$$

If in this symbolical equation we suppose the subject to be unity, we shall have

$$e^{\psi D} fx \, e^{-\psi D} 1 = f(x + \psi' D) \, 1. \qquad (17)$$

This is a remarkable extension of Taylor's theorem, when stated in the symbolical form; and will be found useful in the interpretation of symbolical expressions which are met with in the solution of differential equations. In the development of the right-hand member of formulæ (15) and (16), the terms involving D may be all brought by means of the theorems (6) and (8) to the right or left hand at pleasure. The formulæ thus obtained will be found of considerable use.

In the deduction and statement of theorems involving π and ρ, we shall find it convenient to employ the symbols

$$\frac{d}{d\pi} \text{ and } \frac{d}{d\rho},$$

either of which denotes the operation of taking the *derivée*, in an algebraic sense, of any function of the symbol involved in it. According to this definition $\frac{d}{d\pi}$ must operate on π only where it appears *explicitly*; and so for $\frac{d}{d\rho}$.

Hence $\frac{d}{d\pi}$ is inoperative on ρ, or any function of it, and is commutative with ρ. So also $\frac{d}{d\rho}$ is commutative with π, or any function of it. The two symbols $\frac{d}{d\pi}$ and $\frac{d}{d\rho}$ are plainly commutative with one another; but they combine respectively

with π and ρ, in conformity with the law expressed by the equations,

$$\frac{d}{d\pi}\pi = \pi\frac{d}{d\pi} + 1,$$

$$\frac{d}{d\rho}\rho = \rho\frac{d}{d\rho} + 1.$$

The formulæ (6) and (8) may now be expressed in the symbolical form,

$$\phi\rho \;\; \psi\pi = e^{\frac{d}{d\pi}\frac{d}{d\rho}}\psi\pi \;\; \phi\rho, \tag{18}$$

$$\psi\pi \;\; \phi\rho = e^{-\frac{d}{d\pi}\frac{d}{d\rho}}\phi\rho \;\; \psi\pi. \tag{19}$$

But it must be observed that they are no longer as general as they were in their original form. The equations (6) and (8) would hold good, whatever expression involving π and ρ was written to the right of each of their terms. Whilst the operation of the exponentials in (18) and (19) must be restricted to the terms $\psi\pi \; \phi\rho$ and $\phi\rho \; \psi\pi$, which immediately follow them, and not allowed to affect the subject operated on by these terms.

As $\frac{d}{d\rho}$ is commutative with π, and $\frac{d}{d\pi}$ with ρ, we may write the formulæ (18) and (19) in the form,

$$\phi\rho \;\; \psi\pi = \psi\left(\pi + \frac{d}{d\rho}\right)\phi\rho,$$

$$\psi\pi \;\; \phi\rho = \phi\left(\rho - \frac{d}{d\pi}\right)\psi\pi,$$

and, for the same reason, are at liberty to develope

$$\psi\left(\pi + \frac{d}{d\rho}\right)$$

according to ascending powers of either π or $\frac{d}{d\rho}$. A similar observation applies to the development of

$$\phi\left(\rho - \frac{d}{d\pi}\right).$$

The very general theorems already stated may be extended to any number of systems of variables connected by equations, such as define the mutual action of π and ρ. Thus, if

$$\rho\pi = \pi\rho + 1,$$

and

$$\rho_1\pi_1 = \pi_1\rho_1 + 1,$$

the symbols being otherwise mutually commutative, we shall have

$$f(\rho, \rho_1)\,\phi\,(\pi, \pi_1) = e^{\frac{d}{d\pi}\frac{d}{d\rho} + \frac{d}{d\pi_1}\frac{d}{d\rho_1}}\,\phi\,(\pi, \pi_1) f(\rho, \rho_1),$$

and so on for any number of pairs of symbols.

Again, as a generalization of the formula (15), we shall find, if ψ denotes a function of π and π_1,

$$f\left(\rho + \frac{d\psi}{d\pi}, \ \rho_1 + \frac{d\psi}{d\pi_1}\right) = e^{-\psi} f(\rho, \rho_1)\, e^{\psi}.$$

And, analogous to (16),

$$f\left(\pi + \frac{d\psi}{d\rho}, \ \pi_1 + \frac{d\psi}{d\rho_1}\right) = e^{\psi} f(\pi, \pi_1)\, e^{-\psi};$$

ψ denoting in this case a function of ρ and ρ_1. Writing x and y for π and π_1, and $\frac{d}{dx}$ and $\frac{d}{dy}$ for ρ and ρ_1 in these latter formulæ, we obtain results of considerable importance, the statement and discussion of which is reserved for the concluding part of this Paper.

The Secretary read a paper by W. H. Harvey, M.D., on the Marine Botany of Western Australia.

Robert Ball, LL.D., drew the attention of the Academy to the fact, that in the celebrated statue, known as the Dying

Gladiator, the figure was represented as lying on two trumpets, and had on its neck a torque. Dr. Ball exhibited a remarkably well-executed statuette copy of the figure, kindly lent him by Mrs. Hutton, and pointed out that the trumpets were in form and dimension excellent representations of the larger part of the fine trumpet found at Banbridge, and now in the Museum of the Academy. In the statue they appear connected, the larger end of one to the smaller end of the other by a strap or thong. This induced him to believe, that in the original statue, not two trumpets, but two pieces, identical with those in the Academy, were represented, and that in the restoration of the right arm, &c., which took place when the statue was found, the artist had added a bell-mouth to the curved cylindrical tube, believing that two trumpets should have been figured, not knowing that these instruments were made in two or more pieces: it is not probable that two exactly similar trumpets were carried. The mode of attachment of the strap points out its use, i. e. to hold the trumpet in its proper position when put together; and in the figures on the column of Trajan, several men, probably Dacians, are represented blowing trumpets resembling the Irish specimen, and with the strap attached and strained in the manner of a bow-string. The date of the statue in question has been much disputed. Byron, it does not appear on what authority, in his beautiful notice of the Dying Gladiator, assumes that he was a Dacian, and the figures on Trajan's column seem to support this view: however, learned artists, for the greater part, give it a higher antiquity. With respect to the torque on the neck, it appears to be a very fair representation of the general form of the torques found in Ireland. It may be observed, similar ornaments are said to be in use in the interior of Africa,—a fact known long since, it appears, by a fine old picture, the property of Dr.

O'Ferrall, in which an African slave is represented as having a heavy golden torque on his neck.

A copy of the London Obsequies, found by the Hon. C. Neville at Little Wilbraham, was presented by the Secretary, on the part of Sir John Young, Bart.

The thanks of the Academy were voted for this valuable donation.

MONDAY, JANUARY 8TH, 1855.

THOMAS ROMNEY ROBINSON, D.D., PRESIDENT, in the Chair.

THE Right Hon. Francis Blackburne; Richard G. Butcher, Esq.; James H. Owen, Esq.; and Edward Senior, Esq., were elected Members of the Academy.

On the recommendation of the Council it was Resolved:—

I. To place the sum of £50 at the disposal of the Committee of Antiquities, for the purchase of antiquities.

II. That permission be given to the Council to exchange with Mr. Anketell a modern representation of the Crucifixion, made of ivory, and not Irish, now in the Academy's collection, for one made of bronze, and probably of great antiquity, and of native manufacture.

Rev. Joseph Galbraith read a Paper by Capt. H. L. Renny, C. E., on the Use of the Hygrometer in the Barometric Measurements of Heights.

Dr. Allman read a Paper on the existence of a true medusoid structure in the male gemmæ of Hydra.

In this communication the author endeavoured to demonstrate that the peculiar spermatophorous tubercles which are developed upon the body of Hydra at the commencement of winter, possess a true medusoid type of structure, and thus form no exception to the general law which he had already enunciated, that the fixed reproductive capsules of the hydroid zoophytes are constructed on the medusoid type, and that for

true sexual reproduction in these animals the existence of such a type is a necessary condition.

In *Hydra fusca* the organs in question consist, in their early stage, of minute depressed tubercles, attached by the whole of their broad base to the body of the Hydra. In their completely developed condition they present the appearance of more or less spherical capsules, attached by a contracted base to the Hydra, and slightly prolonged at the opposite point into a small mamilla, which is alternately perforated by an aperture for the egress of the contents.

Into the interior of these bodies the gastric cavity of the Hydra is continued as a blind sac, which occupies the axis of the capsule and gives off from its sides numerous ramified tubes, which extend themselves in the interval between the central sac and the walls of the capsule. In these tubes, whose cavity, however, does not seem to communicate with that of the central sac, the spermatozoa appear to be developed, and subsequently escape into the cavity of the capsule to be finally expelled through the aperture in its summit.

We have here, as in Cordylophora and the marine Hydroida, the walls of the capsule representing the disc of a Medusa, the central sac homologous with the stomach, and the spermatophorous tubes with the radiating gastro-vascular canals.

The spermatozoa possess a conical body with a long caudal filament attached to the larger end. They are produced in the interior of vesicles of evolution, a single spermatozoon being formed in each vesicle, and the vesicles themselves are produced in the interior of mother-cells. These mother-cells may generally be seen to contain two or three spermatozoa, which appear to be often free on the mother-cell, but which are also doubtless frequently contained each in its own vesicle of evolution, though the extreme delicacy of the latter renders it invisible through the walls of the surrounding cell. Very frequently the bodies of the spermatozoa may be seen still in-

uded within the mother-cell, while the tails have become isengaged and vibrate freely in the external fluid.

In the mother-cells, besides the spermatozoa in their vesi-es of evolution, a large, well-defined, nucleus-like body, with onsiderable refractive powers, seems to be invariably pre-ent.

The motions of the free spermatozoa are peculiar, and con-st in a succession of sudden jerks.

By permission of the Academy, Mr. T. A. Dillon ex-ained a plan of his for ascertaining the deviation of ships' ompasses arising from local attraction.

"Sir,—I have the honour to submit, for the consideration the Royal Irish Academy, a plan which I hope will tend some degree towards reassuring the proprietors and com-anders of iron ships, whose uneasiness in consequence of Dr. coresby's communication, 'On the Influence of Iron Ships er their own Compasses,' has been, and still continues to be, the most serious character.

"What Dr. Scoresby says is this:—'So soon as a vessel ade of iron puts to sea and undergoes the tossing and strain-g of the waters, she becomes an immense magnet, as it were, mething in the same way that a poker is transformed into a agnet by striking it repeatedly with a hammer.' And this stinguished philosopher goes on to state, that the loss of the ayleur, and of many other iron vessels, can be assigned to no her cause than to the very startling one above mentioned; r the proximity of such an enormous magnet to the delicate mpass needles disturbs and overrules these instruments as a atter of course. The ship goes astray, and all hands perish.

"Now, it little matters whether Professor Scoresby's magne-theory be correct in every particular or not. We know that e most admirably constructed instruments have mysteriously ne wrong, even after every scientific precaution had been ken to preserve and compensate them in the most perfect

manner. Whatever be the true theory, we know that vessels have been lost, and the only plan as yet proposed for obviating this danger is a recommendation by Dr. Scoresby himself, to place a compass at the mast-head for reference in case of suspicion, which is merely tantamount to saying, that the disease baffles, for the present at least, all his scientific skill. Professor Scoresby is wise enough to know that the motion of a compass situated on the top of a mast, even when masts are forthcoming, which sometimes is *not* the case, would cause the most perfect gimbals to sulk or give way. Again, a steam-ship's funnel is made of iron, which fact confuses matters more than ever.

"We make out plainly enough, however, that the more distant a compass can be placed from the seat of danger, the more trustworthy it becomes in the eyes of the ship's commander. Consequently if, regardless of masts or internal attraction, we can have a reference compass always at hand, the binnacle instruments may try any vagaries they please without disturbing the ship's running in the least. Day by day we remark their deviation, and make allowances accordingly.

"My plan is meant as a simple mode of discovering the error to which the binnacle compasses are liable in consequence of the ship's local attraction.

"1st. Let it be granted that a line may be drawn along the keel of the vessel, and prolonged indefinitely astern.

"2nd. That there exists astern of the ship a point on this line where, if we place a compass, the needle does not suffer from the ship's influence, but exhibits the true polarity.

"Now the difference between the binnacle compass and the compass alluded to must be the error we so anxiously wish to discover. As magnetic attraction decreases as the square of the distance, I should say that a compass one hundred yards or so astern would not be influenced by the iron of the ship: consequently :—

"See that the jolly-boat, towing under the counter, drops astern a hundred yards or so, and that it contains a careful officer and good compass, seeing of course that the boat is free from *iron* ballast, rings, &c. Pay out the tow-line until the boat, as described, is a hundred yards astern. One officer is now in the boat; another stands by the binnacle compass; a third takes his position at the taffrail, looking towards the boat. The officer in the boat, and the officer at the binnacle, each keeps one eye, as it were, upon his respective instrument, and one upon a little flag which the third officer, who stands at the taffrail, holds in his hand. The moment this look-out officer finds the jolly-boat's head and stern to be on a line with the keel of the ship, he lowers the flag. The other two officers check their respective compasses as the flag falls. *The difference between the ship's compass and the boat's compass is the error sought after.*

"Because, if the ship's course was 'due east,' the course of the boat was 'due east' likewise, since her head and stern were in a line with the ship's head and stern by observation. If the course of the ship and boat were 'due east,' the *fleur de lis* on binnacle and boat should stand *at right angles* to the bows of ship and boat. But the local attraction of the ship interferes with this result, and as the boat's compass is the correct one, the difference between the instruments is the influence of local attraction on board the ship.

"As a first step, this is the simplest mode of escaping from the threatened overturning of our faith in the mariner's compass. The other plans of 'floating compasses' are merely alterations in the form of the experiment, which do not interfere with the principle just detailed in the slightest degree. I give the following as the best I have devised.

"Take a long plank of timber; cut it sharp at either end; make a hole in the middle, insert a compass therein, having a spring so arranged that by *chucking* a trigger the needle is instantly arrested at any point. Place a shining mark at the head and stern of this plank. Now float it astern at the end

of a log-line, and sight the two shining points alluded to from the ship's taffrail. Chuck the line and the thing is done; for on hauling the plank alongside and examining its compass (which, it is needless to remark, is impervious to water), the difference between the plank's head and stern and the ship's head and stern, as taken by observation and the position of their cards at the same moment, indicates, as in the previous experiment, the precise amount of derangement caused to the ship's needle by local attraction.

"In concluding these observations, will you permit me to state that I am not satisfied with Dr. Scoresby's theory? at the same time I cannot presume to deny it as yet, at least. You will notice that my plan is a mechanical test for determining the error of a ship's compass, whether that error arises from imperfect compensation originally, shifting of guns, &c., accidental presence of iron or steel in the immediate neighbourhood of the instrument, or from the percussion and straining of the waters, as Dr. Scoresby has ascertained."

W. R. Wilde, Esq., on the part of George O'Flaherty, Esq., of Lemonfield, presented a curious oval wooden bowl or vessel with handles, and carved out of timber, found in the turf-bog near the old church in the Demesne of Lemonfield, and about four and a half feet from the surface. Two others were found at the same time, but in the haste of the workmen to examine their contents they were broken and lost; the one presented was saved by a gentleman who happened to pass at the time of the discovery. The three vessels contained neither coins nor other antiquities. Mr. Wilde also presented an iron spear-head, a dagger, and swivel gun constructed with a chambered breech, found in 1853 by George Warder, at Inishdauwee, an island in Lough Corrib, near Oughterard. These articles were discovered in consequence of attention being drawn to the spot by a fragment of iron projecting above the surface.

Rev. Dr. Reeves presented a small conical brass box, found in a bog near Cullybacky, county of Antrim; also, for James R. Hutchinson, Esq., a box of the same kind, but larger and older, found in the Demesne of Stranocum, by workmen levelling on the bank of the River Bush, about twenty feet below the surface.

MONDAY, JANUARY 22ND, 1855.

LIEUT.-COL. LARCOM, F.R.S., VICE-PRESIDENT, in the Chair.

REV. PROFESSOR GRAVES, D.D., read a Paper on the solution of the equation of Laplace's functions.

"Mr. Carmichael was the first to observe that the partial differential equation of the second order,

$$\frac{d^2V}{dx^2}+\frac{d^2V}{dy^2}+\frac{d^2V}{dz^2}=0,$$

or (1)

$$D_1^2V+D_2^2V+D_3^2V=0,$$

known as the equation of Laplace's functions, may be reduced, by means of Sir William Hamilton's imaginaries, to the symbolic form,

$$(D_1+jD_2+kD_3)\,(D_1-jD_2-kD_3)\,V=0.$$

Its complete solution is, therefore, the sum of those of the two equations of the first order,

$$(D_1+jD_2+kD_3)\,V=0,$$
$$(D_1-jD_2-kD_3)\,V=0;$$

and these latter solutions have been presented to us by Mr. Carmichael in the symbolic forms,

$$V=e^{-x(jD_2+kD_3)}f_1(y,z), \qquad (2)$$

$$V=e^{x(jD_2+kD_3)}f_2(y,z), \qquad (3)$$

in which f_1 and f_2 stand for quite arbitrary functions. Following, however, too closely the analogies of ordinary algebra, Mr. Carmichael has fallen into an error in interpreting the right-hand members of these formulæ. He has made

$$\epsilon^{-x(jD_2+kD_3)} f_1(y, z) = f_1(y-jx,\ z-kx), \qquad (4)$$

$$\epsilon^{x(jD_2+kD_3)} f_2(y, z) = f_2(y+jx,\ z+kx). \qquad (5)$$

Sir William Hamilton at once perceived the inaccuracy of these results, and referred it to its origin, which was the erroneous supposition, that

$$\epsilon^{jD_2+kD_3} = \epsilon^{jD_2}\epsilon^{kD_3}.$$

This last equivalence does *not* subsist, because the symbols j and k are not commutative.

"Indeed, the consideration of a simple case might lead to the suspicion that the formula (4) was incorrect. Suppose that $f_1(y, z) = yz$: it becomes at once a question, what is the meaning of $f_1(y-jx,\ z-kx)$? Is it $(y-jx)(z-kx)$, or $(z-kx)(y-jx)$? for these expressions have different values. Thus, in the first instance, it is apparent that the assigned result is ambiguous. But from what follows it will appear that neither $(y-jx)(z-kx)$, nor $(z-kx)(y-jx)$, is equivalent to

$$\epsilon^{-x(jD_2+kD_3)} yz.$$

"The question relative to the interpretation of the symbolic formulæ (2) and (3) being in this state, I have endeavoured to resolve it in the present Paper.

"As a first step in our investigation, let us inquire what is the effect of the symbol,

$$\epsilon^{x(jD_2+kD_3)},$$

or π, as it will be more convenient to denote it, upon the term $y^m z^n$, m and n being positive integers.

"Beginning with simple cases, we shall find by actual expansion of the exponential symbol,

1. $\pi\ y^m = (y+jx)^m$, and $\pi\ z^n = (z+kx)^n$.
2. $\pi\ yz = yz + jxz + kxy$.
3. $\pi\ y^2z = y^2z + 2jxyz + kxy^2 - x^2z - \frac{1}{3}kx^3$.
4. $\pi\ y^2z^3 = y^2z^3 + 2jxyz^3 + 3kxy^2z^2 - x^2z^3 - 3x^2y^2z - kx^3z^2$
$\qquad - 2jx^3yz - kx^3y^2 + x^4z + \frac{1}{5}kx^5$.

The first of these results shows that the effect of π upon any function of y alone is to change it into the like function of $y + jx$; and the effect of the same symbol upon any function of z alone is to change it into the like function of $z + kx$.

"But the second example shows that its effect upon yz is to change it, not into either $(y+jx)\ (z+kx)$, or $(z+kx)\ (y+jx)$, but into half the sum of these different expressions. For

$$\tfrac{1}{2}\{(y+jx)\ (z+kz)+(z+kx)\ (y+jx)\} = yz + jxz + kxy,$$

in virtue of the equation $jk + kj = 0$.

"Again, the third example shows that the effect of π upon $y^2 z$ is to change it, not into any one of the three different expressions,

$$(y+jx)^2\ (z+kz),\ \ (y+jx)\ (z+kx)\ (y+jx),\ \text{ and }$$
$$(z+kx)\ (y+jx)^2,$$

but into the third part of the sum of the three. It is easy to see that this result follows from the equations,

$$j^2 = -1,\quad k^2 = -1,\quad jk + kj = 0.$$

"Pursuing the same course we shall find that the effect of π upon $y^2 z^3$ is to change it into the tenth part of the sum of the ten expressions,

$$\begin{aligned}
&(y+jx)^2\ (z+kx)^3,\\
&(y+jx)\ (z+kx)\ (y+jx)\ (z+kx)^2,\\
&(y+jx)\ (z+kx)^2\ (y+jx)\ (z+kx),\\
&(y+jx)\ (z+kx)^3\ (y+jx),\\
&(z+kx)\ (y+jx)^2\ (z+kx)^2,\\
&(z+kx)\ (y+jx)\ (z+kx)\ (y+jx)\ (z+kx),\\
&(z+kx)\ (y+jx)\ (z+kx)^2\ (y+jx),\\
&(z+kx)^2\ (y+jx)^2\ (z+kx),\\
&(z+kx)^2\ (y+jx)\ (z+kx)\ (y+jx),\\
&(z+kx)^3\ (y+jx)^2,
\end{aligned}$$

which arise as the differently arranged products of the five factors, of which two are equal to $y + jx$, and three to $z + kx$.

"Following up the analogy, we are led to expect that the effect of π upon $y^m z^n$ will be to change it into the

$$\left\{\frac{(m+n)!}{m!\,n!}\right\}^{th} \text{part of the sum of all the } \frac{(m+n)!}{m!\,n!}$$

different expressions which arise as the differently arranged products of the $m+n$ factors of which m are equal to $y+jx$, and n to $z+kx$.

" The following reasoning demonstrates the truth of the proposition just stated.

" Let C be the coefficient of $x^{\mu+\nu}\, y^{m-\mu}\, z^{n-\nu}$ in the development of $\pi\, y^m\, z^n$. Then C will be equal to the coefficient of $x^{\mu+\nu} D^2_\mu D^3_\nu$ in the development of

$$e^{x(jD_2+kD_3)},$$

multiplied by

$$m(m-1)\,.\,.\,.\,.\,.\,(m-\mu+1)\,n(n-1)\,.\,.\,.\,.\,.\,(n-\nu+1).$$

But, in the development of the exponential, $D_2^\mu D_3^\nu$ occurs only in the term

$$\frac{x^{\mu+\nu}(jD_2+kD_3)^{\mu+\nu}}{(\mu+\nu)!}:$$

and there has for its coefficient

$$\frac{\Sigma(\mu,\nu)}{(\mu+\nu)!};$$

the numerator $\Sigma(\mu,\nu)$ denoting the sum of all the variously arranged products, into each of which enter μ j s, and ν k s. Consequently, we have

$$C = \frac{m!\,n!}{(m-\mu)!\,(n-\nu)!\,(\mu+\nu)!}\,\Sigma(\mu,\nu).$$

" But again, C_1 the coefficient of $x^{\mu+\nu}\, y^{m-\mu}\, z^{n-\nu}$ in the

$$\left\{\frac{(m+n)!}{m!\,n!}\right\}^{th} \text{part of the sum of the } \frac{(m+n)!}{m!\,n!}$$

differently arranged products of the $m+n$ factors, of which m are equal to $y+jx$, and n to $z+kx$, will be equal to

$$\frac{m!\,n!}{(m+n)!}\,S,$$

where S denotes the sum of all the differently arranged products of $m+n$ factors, of which $m-\mu$ are y s, $n-\nu$ are z s, μ are j s, and ν are k s. Now the *number* of these arrangements in S is

$$\frac{(m+n)!}{(m-\mu)!\,(n-\nu)!\,\mu!\,\nu!},$$

and S itself will obviously be of the form $N\Sigma(\mu, \nu)$, N being some numerical coefficient depending upon m, n, μ, and ν. But as the *number* of differently arranged terms in $\Sigma(\mu, \nu)$ is

$$\frac{(\mu+\nu)!}{\mu!\,\nu!},$$

it is plain that we shall have

$$N = \frac{(m+n)!}{(m-\mu)!\,(n-\nu)!\,(\mu+\nu)!},$$

and consequently,

$$C_1 = \frac{m!\,n!}{(m-\mu)!\,(n-\nu)!\,(\mu+\nu)!}\,\Sigma(\mu, \nu).$$

"Thus, we have found that $C = C_1$, and as this is true for the numerical coefficient of every term in the development of $\pi\, y^m z^n$, we are warranted in concluding that this latter expression is equal to the

$$\left\{\frac{(m+n)!}{m!\,n!}\right\}^{th} \text{part of the sum of all the } \frac{(m+n)!}{m!\,n!}$$

differently arranged products of the $m+n$ factors, of which m are equal to $y+jx$, and n to $z+kx$.

"The statement of this theorem, and of other similar ones, may be rendered simpler and more elegant by our assigning a name and symbol to the last-mentioned expression. I propose to call it the *mean value of the product* of the factors combined in different orders: and for the present to denote it by the symbol

$$M(\overset{m}{y+jx},\ \overset{n}{z+kx}).$$

We may now proceed to interpret the expression

$$e^{x(jD_2+kD_3)}f(y, z),$$

in which $f(y, z)$ is supposed to be of the form

$$\Sigma\, A\, y^m z^n,$$

m and n, as before, being positive integers.

"The exponental symbol being distributive in its nature, we shall have the proposed expression equal to the sum of the mean values of the products corresponding to the several terms such as $Ay^m z^n$. Consequently,

$$e^{x(jD_2+kD_3)}f(y, z) = \Sigma\, AM\, (\overset{m}{y+jx},\ \overset{n}{z+kx}),$$

and, with an interpretation suggested by what has been already said, we may write finally,

$$e^{x(jD_2+kD_3)}f(y, z) = Mf(y+jx,\ z+kx).$$

"The boundaries of algebra having been of late extended so as to include symbols which are not commutative with each other, it becomes absolutely necessary to have the means of denoting certain standard and constantly occurring combinations in brief and unambiguous ways. The symbol M, proposed in this paper, may perhaps be a useful contribution to mathematical language. It has the recommendation of having been already used in a similar, though less extensive, meaning by M. Cauchy. It may also be regarded as an extension of Sir William Hamilton's notation of $S(\alpha, \beta)$, which stands in the Calculus of Quaternions for $\frac{1}{2}(\alpha\beta + \beta\alpha)$.

"Knowing how to interpret the expression,

$$e^{x(jD_2+kD_3)},$$

we are enabled, in general, to solve the equation,

$$D_1^2 V + D_2^2 V + D_3^2 V = U, \tag{6}$$

in which U denotes any function expressed by means of positive and integer powers of x, y, and z. The solution depends upon our being able to invert the operations denoted by

$$D_1 + jD_2 + kD_3, \text{ and } D_1 - jD_2 - kD_3;$$

and as these inverse operations are respectively,

$$e^{-x(jD_2+kD_3)}D_1^{-1}e^{x(jD_2+kD_3)}, \text{ or } \pi^{-1}D_1^{-1}\pi,$$

and

$$e^{x(jD_2+kD_3)}D_1^{-1}e^{-x(jD_2+kD_3)}, \text{ or } \pi\ D_1^{-1}\pi^{-1},$$

we shall have

$$V = \pi D_1^{-1}\pi^{-2}D_1^{-1}\pi\, U + Mf_1(y - jx_1,\ z - kx) + Mf_2(y + jx,\ z + kx),$$

the two latter terms being the solution of (1). This complete solution, when developed, appears, in general, in the form,

$$F_1 + jF_2 + kF_3,$$

F_1, F_2, and F_3, being different functions of x, y, z, which singly satisfy the proposed equation.

"For instance, we have seen above that

$$\begin{aligned} e^{x(jD_2+kD_3)}y^2z^3 = {} & y^2z^3 - x^2(z^3 + 3y^2z) + x^4z, \\ & + 2j(xyz^3 + x^3yz), \\ & + k(3xy^2z^2 - x^3z^2 - x^3y^2 + \tfrac{1}{5}x^5). \end{aligned}$$

It will be found on trial, that each line in the right-hand member will by itself satisfy the equation of Laplace's functions.

"The conclusions already obtained may be further generalized. For the equation,

$$\frac{d^2V}{dw^2} + \frac{d^2V}{dx^2} + \frac{d^2V}{dy^2} + \frac{d^2V}{dz^2} = U,$$

in which U is a function of w, x, y, and z, may be reduced to the symbolic form,

$$(D + iD_1 + jD_2 + kD_3)(D - iD_1 - jD_2 - kD_3)V = U,$$

the solution of which depends on the inversion of the operators,

$$D + iD_1 + jD_2 + kD_3, \text{ and } D - iD_1 - jD_2 - kD_3.$$

Putting

$$iD_1 + jD_2 + kD_3 = \triangleright,$$

a notation employed by Sir William Hamilton, we shall have

$$(D + \triangleright)^{-1} = e^{-w\triangleright} D^{-1} e^{w\triangleright},$$

$$(D - \triangleright)^{-1} = e^{w\triangleright} D^{-1} e^{-w\triangleright}.$$

Consequently,

$$V = e^{w\triangleright} D^{-1} e^{-2w\triangleright} D^{-1} e^{w\triangleright} U$$

$$+ e^{-w\triangleright} f_1(x, y, z) + e^{w\triangleright} f_2(x, y, z), \qquad (7)$$

and to interpret this we must ascertain what is the effect of the symbol

$$e^{w\triangleright},$$

upon any function of x, y, and z.

"Reasoning as before, we should find that its effect upon a term $x^l y^m z^n$, l, m, and n being positive integers, will be to change it into the

$$\left\{\frac{(l+m+n)!}{l!\,m!\,n!}\right\}^{th} \text{ part of the sum of all the } \frac{(l+m+n)!}{l!\,m!\,n!}$$

differently arranged products of the $l+m+n$ factors, of which l are equal to $x + iw$, m to $y + jw$, and n to $z + kw$. In other words, to change it into the *mean value* of this product, that is, into

$$M(x \overset{l}{+} iw,\ y \overset{m}{+} jw,\ z \overset{n}{+} kw):$$

and, more generally, the effect of

$$e^{w\triangleright}$$

upon $f(x, y, z)$, any function consisting of positive and integer powers of x, y, and z, will be to change it into

$$Mf(x + iw,\ y + jw,\ z + kw).$$

We are thus enabled to interpret the formula (7), when U, f_1, and f_2, are functions of positive and integer powers. To that case the demonstrations given in this paper are essentially limited. I hope to be able to lay before the Academy the investigation of the cases where l, m, and n, are negative or fractional. So far as I have yet discussed them, they seem to present results which it is more difficult to express with elegance.

"In conclusion, I may be permitted to state some theorems at which I arrived whilst discussing the subject of the present

paper. In fact, I at first imagined that the proof of them was necessary to my purpose. They are obtained as follows:—

"In virtue of the laws of combination of the imaginaries i, j, k, we have

$$(ia + jb + kc)^{2\lambda+2\mu+2\nu} = (-1)^{\lambda+\mu+\nu} (a^2 + b^2 + c^2)^{\lambda+\mu+\nu}. \qquad (8)$$

Now, the coefficient of $a^{2\lambda}b^{2\mu}c^{2\nu}$ in the left-hand member of this equation is $\Sigma(2\lambda, 2\mu, 2\nu)$, in conformity with the notation explained in p. 165: and the same coefficient in the right-hand member is plainly

$$(-1)^{\lambda+\mu+\nu} \frac{(\lambda + \mu + \nu)!}{\lambda!\,\mu!\,\nu!}.$$

Consequently, we have the theorem I.

$$\Sigma(2\lambda, 2\mu, 2\nu) = (-1)^{\lambda+\mu+\nu} \frac{(\lambda + \mu + \nu)!}{\lambda!\,\mu!\,\nu!}.$$

"Multiplying both sides of the equation (8) by $ia + jb + kc$, we get

$$(ia + jb + kc)^{2\lambda+1+2\mu+2\nu} = (-1)^{\lambda+\mu+\nu} (ia + jb + kc)(a^2 + b^2 + c^2)^{\lambda+\mu+\nu}.$$

The coefficient of $a^{2\lambda+1} b^{2\mu} c^{2\nu}$ in the left-hand member is $\Sigma(2\lambda + 1, 2\mu, 2\nu)$; and the same coefficient in the right-hand member is

$$(-1)^{\lambda+\mu+\nu} \frac{(\lambda + \mu + \nu)!}{\lambda!\,\mu!\,\nu!}\, i.$$

We have, therefore, II.,

$$\Sigma(2\lambda + 1, 2\mu, 2\nu) = (-1)^{\lambda+\mu+\nu} \frac{(\lambda + \mu + \nu)!}{\lambda!\,\mu!\,\nu!}\, i,$$

and similar expressions for j and k.

"Again, multiplying (8) by $(ia + jb + kc)^2 = -(a^2 + b^2 + c^2)$, we get

$$(ia + jb + kc)^{2\lambda+1+2\mu+1+2\nu} = (-1)^{\lambda+\mu+\nu+1} (a^2 + b^2 + c^2)^{\lambda+\mu+\nu+1}.$$

The coefficient of $a^{2\lambda+1} b^{2\mu+1} c^{2\nu}$ in the left-hand member is $\Sigma(2\lambda + 1, 2\mu + 1, 2\nu)$; whilst in the development of the right-hand member no such term appears, as all the exponents of a, b, c, must be even numbers. We have, therefore, III.,

$$\Sigma(2\lambda+1,\ 2\mu+1,\ 2\nu)=0,$$

If $\lambda=0$, we must put 1 in place of $\lambda!$ in the preceding formulæ."

Sir William R. Hamilton made some remarks on Professor Graves' Paper.

Dr. Aquilla Smith presented the following donation from the Archdeacon of Clonmacnoise:

1. Coloured window glass, seventeen fragments:—one fragment in lead fitting; two fragments of lead fittings for glass: from the Abbey of St. Peter and St. Paul, Newtown, Trim.

2. Oval silver reliquary and medal.

3. Ten Italian medals in brass and copper.

4. Two bullæ; a figure representing St. Patrick; a weight stamped with a heart and the letters J. B.; a square ingot or weight; and a small cup: all made of lead.

5. Two silver, one gold, and one brass brooch; one bead made of white glass, with blue stripes.

6. Three silver and four brass finger rings; four rings, iron and brass.

7. One silver and nine brass buckles, of different patterns.

8. Three very small spoons, and two fragments of large spoons.

9. A coat button with glass centre.

10. Two ornaments and harp pin, made of brass.

11. Two pins and portions of a comb, made of bone.

12. One brass and seven iron keys.

13. One old matchlock and fragment of iron chain.

14. One small padlock and stopper for key-hole of safe.

15. One pommel of sword and arrow-head; two knives and one large fork; made of iron.

16. One spur, with silver ornaments, and large rowel of another: made of iron.

17. One ring and small cross, made of stone. All these were found at Trim or Newtown.

18. One large brass thimble, found at Bective Abbey.

Dr. Aquilla Smith, on the part of F. Higgins, Esq., presented a small hammer, made of porphyry, and found at Higginsbrook, near Trim.

MONDAY, FEBRUARY 12TH, 1855.

JOHN ANSTER, LL.D., in the Chair.

THE Rev. Robert Carmichael, F.T.C.D.; Alexander Carte, M.D.; and the Rev. Ogle William Moore, were elected Members of the Academy.

Professor Downing read a Paper on the draining of the Haarlem Lake.

The lake of Haarlem, situated in North Holland, contains 44,500 acres, which, previous to its drainage, was covered with a depth of thirteen feet of water, the surface of which was under the mean tide level of the sea; it is now completely dry and under cultivation.

To have an adequate idea of the difficulties encountered in bringing this work to a successful termination, it is necessary to consider the peculiar physical and artificial circumstances of the Netherlands. The greater portion of the surface is at or below the level of the sea, and only protected from being again covered with water by immense dykes, which guard it alike from the rivers and the sea. Along the greater portion of its western boundary, it is, however, in a great degree protected by the *dunes* or sand-hills which form the coast line. The rise of tide along the coasts of the Zuyder Zee is only two feet, and upon the west, in the German Ocean, it is six feet, the mean level being very nearly the same. The annual rain-fall, as deduced from observations continued for nearly one hundred years, is on the average 25·15 inches; the mean annual evaporation is 22·6 inches, distributed, however, very unequally in the winter and summer seasons, thus:

	Summer.	Winter.	Total.
Fall of rain, .	10·5 in. .	14·65 in. .	25·15 in.
Evaporation, .	15·9 „ .	6·7 „ .	22·6 „
	−5·4 in. .	+7·95 in. .	=2·55 in.

As to the artificial features of Holland, we find that from the very earliest times it has been divided into districts of greater or less extent, placed under the control of a governing body (*Waterschappen*), which we may call the Hydraulic Administration; the boundaries of these administrations (which are not conterminous with those of the provinces, or any fiscal or municipal districts) are formed by large and lofty dykes, in which are placed self-acting sluices for the discharge of the waters within the boundary dyke, and closing against the admission of any of the external waters. Lake Haarlem is situated in the administration of the Rynland, which has discharging sluices into the German Ocean at Katwyck, into the Zuyder Zee at Sparndam and Halfwege, and into the river Yssell at Gouda.

Within every Hydraulic Administration are three divisions of surface, called the Natural Lands, the Basin, and the Polders. The basin is the total area of water-surface within the boundary dyke; the natural lands are a little above the level of the basin, and discharge the rain-fall off their surface naturally; the polders are lands below the level of the basin, at various depths, from a few inches to twenty feet, and from which, consequently, the water must be raised mechanically, by windmills generally, and latterly by steam-power. The Rynland contains—

Basin, ...	56,000 acres.
Natural lands, ...	76,000 „
Polders, ...	173,000 „
	305,000 acres.

Lake Haarlem, which had been part of the basin, is now added to the polders, so that, instead of 56000 and 173000 acres, we now have 11500 acres of basin, and 217500 acres of polders, in this Administration. Regarding, then, the basin in its most important duty, that, namely, of a receptacle of the rain-fall when the self-acting sluices may happen to be closed against the external waters, we see how greatly its powers of

storage are now reduced. To obviate this disadvantage it was necessary to put up engines of 200 and 100 horse-power at Sparndam and Halfwege, and widen the channel leading to the Katwyck sluice. Another work preliminary to the drainage was the navigable canal (*Ringvart*), adapted to vessels drawing 8 feet of water, which previously traversed the lake; this canal had a total length of 36 miles, and width of 146 feet, the inner bank being in fact the dyke surrounding the lake, and cutting off the waters which otherwise would flow in during and after the laying dry of the bed.

All preliminary works being thus completed, the raising of the waters up to the level of the sea was effected by three engines of 350 horse-power each, on the Cornish principle, constructed by Harvey and Co., at Hayle foundry, after designs by Messrs. Gibbs and Deane; the cylinders were 12 feet diameter and 10 feet stroke. From numerous and unforeseen causes of delay they were thirty-nine months in raising the water; and instead of 800000000 of tons of water, the computed contents of the lake, they actually raised 1100000000 tons. These engines will be required for all time to keep dry the land they may be said to have created, not, however, by that continuous working by which the first operation has been performed, but by throwing off extraordinary rain-falls before they have injuriously affected the land. Eight inches of rain-fall and infiltration per month is the maximum quantity that long-continued observations lead them to expect, and this can be raised in about twenty-five working days by the 1150 horse-power of the three engines.

The original estimated cost of all the works of the drainage was £687500; the actual expenditure, £827200. The sale of the land has realized about £400000, and the land tax, 7*s.* 4*d.* per acre, being capitalized, would yield a like sum; nor must we omit the saving of £5000 per annum, formerly expended in guarding the banks of the lake from destruction during storms, but which now of course ceases.

The Rev. Samuel Haughton, M.A., Professor of Geology in the University of Dublin, read a Paper on the chemical composition and optical properties of the Mica of the Dublin, Wicklow, and Carlow granites.

"The minerals included in the mica family may be divided into various groups, founded on their chemical composition and optical properties.

"Chemically considered, they are divided by Rammelsberg and others into three families:—

1. Potash mica.
2. Lithia mica.
3. Magnesia mica.

"Optically considered, they are divided into three groups also:—

1. Biaxial micas, the angle between the optic axes being from 44° to 75°.
2. Biaxial micas, with angle between optic axes from 5° to 20°.
3. Biaxial and uniaxial micas, with angle between optic axes from 5° to 0°.

"The first optical group includes the potash and lithia micas of the chemical division, while the third chemical group, or Magnesia mica, is divided between the second and third optical groups; the second group being usually designated Phlogopite, and the third Biotite. The potash and lithia micas are considered by Rammelsberg as represented by the following general formula—

$$m(RO, SiO_3) + n(R_2O_3, SiO_3)$$

in which formula, in the potash micas

$$m = 1$$
$$n = 2, 3, \text{ or } 4.$$

"The last two cases, $n = 3$ and $n = 4$, being the Muscovite of mineralogists, and the first, $n = 2$, or

$$ROSiO_3 + 2(R_2O_3SiO_3) + kHO$$

being known as Margarodite.

"The Micas of the Dublin, Wicklow, and Carlow granites, analyzed by me, belong to the Margarodite genus, and contain two atoms of water, corresponding to k = 2.

"The following are the analyses of three micas selected from three distant localities of the granite chain of the south-east of Ireland.

"No. 1. Mica from the Three-Rock Mountain, county of Dublin; gray, transparent, containing specks or flakes of a bronze-coloured or black mica.

	Per Cent.	Atomic Quotients.			
Silica,	43·47	0·959		2·863	3
Alumina,	31·42	0·611	0·670	2·000	2
Peroxide of iron,	4·79	0·059			
Lime,	1·38	0·049	0·379	1·131	1
Magnesia,	1·13	0·056			
Potash,	10·71	0·228			
Soda,	1·44	0·046			
Loss by ignition,	5·43	0·603		1·800	2
	99·77				

"No. 2. Mica from Glendalough valley, county of Wicklow, gray, transparent, with specific gravity = 2·793.

	Per Cent.	Atomic Quotients.			
Silica,	44·71	0·987		2·973	3
Alumina,	31·13	0·606	0·664	2·000	2
Peroxide of iron,	4·69	0·058			
Lime,	1·09	0·035	0·332	1·000	1
Magnesia,	0·90	0.045			
Potash,	9·91	0·211			
Soda,	1·27	0·041			
Loss by ignition,	6·22	0·691		2·083	2
	99·92				

"No. 3. Mica from Mount Leinster, county of Carlow, gray, transparent.

	Per Cent.	Atomic Quotients.			
Silica,	44·64	0·970		2·913	3
Alumina,	30·18	0·587	0·666	2·000	2
Peroxide of iron,	6·35	0·079			
Lime,	0·00	0·000	0·298	0·900	1
Magnesia,	0·72	0 036			
Potash,	12·40	0 262			
Soda,	Trace,	0·000			
Loss by ignition,	5·32	0·591		1·774	2
	99·61				

"If we take the mean of these analyses we find—

Average Mica of Dublin, Wicklow, and Carlow Granite.

	Per Cent.	Atomic Quotients.		
Silica,	44·27	0·962		3
Alumina,	30·91	0·601	0·667	2
Peroxide of iron,	5·27	0·066		
Lime,	0·82	0·029	0·338	1
Magnesia,	0·92	0·046		
Potash,	11·01	0·234		
Soda,	0·90	0·029		
Loss by ignition,	5·66	0·629		2
	99·76			

"There can be little doubt, from the foregoing analyses, that the transparent gray Mica of the district under consideration is a Margarodite, having the rational formula

$$ROSiO_3 + 2(R_2O_3, SiO_3) + 2HO.$$

The mica which deviates most from this formula is the mica of the Three Rock Mountain, and this deviation may possibly be due to the presence of grains of black mica, which also occurs in the mass of the granite, and of which I was unable to obtain a sufficient quantity for chemical or optical examination; the quantity of protoxides in the Three Rock mica is somewhat in excess of that required by the formula.

"The angles between the optic axes of these micas were carefully determined, and found to be as follows:—

Angles between Optic Axes of Micas.

1. Three Rock mica, ...	53°	8′
2. Glendalough mica, ...	70	4
3. Mount Leinster mica, ...	72	18
4. Lough Dan mica, ...	70	0
5. Glenmalure mica, ...	67	11

"I have added to the determination of angles of the micas analyzed the optic angles of two other specimens of gray, transparent mica from Lough Dan and Glenmalure, county of Wicklow.

"The four micas which were free from any intermixture of black mica have a high angle, while the angle between the optic axes of the mica from the Three Rock Mountain, which contained flakes of black mica, is nearly 20° less than that of the pure transparent gray micas.

"I think that the uniformity of the preceding analyses is sufficient to show that Margarodite is entitled to be considered as a distinct species of hydrated mica, and that it is not merely an altered form of Muscovite, an opinion advocated by Mr. Dana, in the last edition of his 'System of Mineralogy.'"

James Apjohn, M. D., made some remarks on Mr. Haughton's communication.

The Secretary read a letter from Mr. Hornsby, Secretary to the Board of Works, presenting to the Academy Museum the following articles:—

1. A small wooden bucket or situla, bound with bronze hoops, having perforated lozenge patterns.

2. Ornamented bead, composed of blue glass, with bands of red and white glass.

3. Bone bead or ornament.

4. Fragments of bone comb.

5. Neck and handles of an earthen jar.

6. Head of a fibula, ornamented with a curious mosaic.

7. Bronze hoop.

8. Bronze spear.

9. Three dorsal vertebræ.

10. Os pelvis.

11. Boar's tusk. All found in the river bed, between Aunagassin and Castle Bellingham.

12. Bottom of an ancient bronze vessel, curiously ornamented with raised bands.

13. Large elk's head and horns, found in the bed of the river Dee, between Nobber and Whitewood, in the county of Meath.

14. Small brass pin or bodkin, found in the river Glyde, about a mile below Castle Bellingham.

Dr. Ball made some remarks on the animal remains; and Mr. Wilde drew the attention of the Academy to the bucket, which resembled two others in the Museum.

Dr. Tuffnell exhibited a curious wooden staff, with Turkish inscriptions, which he procured at Silistria, and read translations of the inscriptions made by Mr. Benmohel.

Monday, February 26th, 1855.

THOMAS ROMNEY ROBINSON, D.D., President, in the Chair.

Rev. Professor Graves communicated the following extract from a letter addressed to him (under date of January 26th, 1855) by Sir William R. Hamilton :—

"My dear Graves,—You may like, perhaps, to see a way in which I have to-day, for my own satisfaction, confirmed (not that they required confirmation) some of the results announced by you to the Academy on Monday evening last.

"Let us then consider the function (suggested by you),

$$\Sigma\ i^l j^m n^n = (l,\ m,\ n)\ i^l j^m k^n\ ; \tag{1}$$

where l, m, n are positive and integer exponents (0 included); the summation Σ refers to all the possible arrangements of the $l+m+n$ factors, whereof the number is

$$N_{l,\,m,\,n} = \frac{(l+m+n)\,!}{l\,!\ m\,!\ n\,!}\ ; \tag{2}$$

each of these N arrangements gives (by the rules of ijk) a product $= \pm 1 \,.\, i^l j^m k^n$; and the sum of all these positive or negative unit-coefficients, ± 1, thus obtained, is the numerical coefficient denoted by $(l,\ m,\ n)$.

"Since each arrangement must have i or j or k to the left, we may write,

$$\Sigma\ i^l j^m k^n = i\Sigma i^{l-1} j^m k^n + j\Sigma i^l j^{m-1} k^n + k\Sigma i^l j^m k^{n-1}\ ; \tag{3}$$

and it is easy to see that the coefficient $(l,\ m,\ n)$, or the sum $\Sigma\,(\pm 1)$, vanishes, if *more than one* of the exponents, l, m, n, be odd. Assume, therefore, as a new notation,

$$(2\lambda,\ 2\mu,\ 2\nu) = \{\lambda,\ \mu\ \nu\}\ ; \tag{4}$$

which will give, by (3), and by the principle last mentioned respecting odd exponents,

$$(2\lambda + 1,\ 2\mu,\ 2\nu) = \{\lambda,\ \mu,\ \nu\};$$
$$(2\lambda - 1,\ 2\mu,\ 2\nu) = \{\lambda - 1,\ \mu,\ \nu\}. \tag{5}$$

We shall then have, by the mere notation,

$$\Sigma\, i^{2\lambda} j^{2\mu} k^{2\nu} = \{\lambda,\ \mu,\ \nu\}\, i^{2\lambda} j^{2\mu} k^{2\nu}; \tag{6}$$

and, by treating this equation on the plan of (3),

$$\{\lambda, \mu, \nu\} = \{\lambda - 1, \mu, \nu\} + \{\lambda, \mu - 1, \nu\} + \{\lambda, \mu, \nu - 1\}. \tag{7}$$

By a precisely similar reasoning, attending only to j and k, or making $\lambda = 0$, we have an expression of the form,

$$\Sigma\, j^{2\mu} k^{2\nu} = \{\mu,\ \nu\}\, j^{2\mu} k^{2\nu}, \tag{8}$$

where the coefficients $\{\mu,\ \nu\}$ must satisfy the analogous equation in differences,

$$\{\mu,\ \nu\} = \{\mu - 1,\ \nu\} + \{\mu,\ \nu - 1\}, \tag{9}$$

together with the initial conditions,

$$\{\mu,\ 0\} = 1, \quad \{0,\ \nu\} = 1. \tag{10}$$

Hence, it is easy to infer that

$$\{\mu,\ \nu\} = \frac{(\mu + \nu)\,!}{\mu\,!\ \nu\,!}; \tag{11}$$

one way of obtaining which result is, to observe that the generating function has the form,

$$\Sigma\ \{\mu,\ \nu\}\, u^\mu v^\nu = (1 - u - v)^{-1}. \tag{12}$$

In like manner, if we combine the equation in differences (7), with the initial conditions derived from the foregoing solution of a less complex problem, namely, with

$$\{0, \mu, \nu\} = \{\mu,\ \nu\}, \quad \{\lambda,\ 0,\ \nu\} = \{\lambda,\ \nu\}, \quad \{\lambda,\ \mu,\ 0\} = \{\lambda,\ \mu\}, \tag{13}$$

when the second members are interpreted as in (11), we find that the (slightly) more complex generating function sought is,

$$\Sigma\ \{\lambda,\ \mu,\ \nu\}\, t^\lambda u^\mu v^\nu = (1 - t - u - v)^{-1}; \tag{14}$$

and therefore that the required form of the coefficient is,

$$\{\lambda, \mu, \nu\} = \frac{(\lambda+\mu+\nu)!}{\lambda!\,\mu!\,\nu!}; \tag{15}$$

as, I have no doubt, you had determined it to be.

" With the same signification of { }, we have, by (2),

$$N_{l,\,m,\,n} = \{l, m, n\}; \tag{16}$$

therefore, dividing Σ by N, or the *sum* by the *number*, we obtain, as an expression for what you happily call the MEAN VALUE of the product $i^{2\lambda}j^{2\mu}k^{2\nu}$, the following:

$$M\, i^{2\lambda}j^{2\mu}k^{2\nu} = \frac{\{\lambda, \mu, \nu\}}{\{2\lambda, 2\mu, 2\nu\}}\, i^{2\lambda}j^{2\mu}k^{2\nu}; \tag{17}$$

or, substituting for { } its value (15), and writing for abridgment

$$\kappa = \lambda + \mu + \nu, \tag{18}$$

$$M\, i^{2\lambda}j^{2\mu}k^{2\nu} = \frac{(-1)^\kappa\, \kappa!\,(2\lambda)!\,(2\mu)!\,(2\nu)!}{(2\kappa)!\quad \lambda!\quad \mu!\quad \nu!}. \tag{19}$$

In like manner,

$$M\, i^{2\lambda+1}j^{2\mu}k^{2\nu} = \frac{i(-1)^\kappa\, \kappa!\,(2\lambda+1)!\,(2\mu)!\,(2\nu)!}{(2\kappa+1)!\quad \lambda!\quad \mu!\quad \nu!}. \tag{20}$$

" The whole theory of what you call the *mean values*, of *products* of positive and integer *powers* of ijk, being contained in the foregoing remarks, let us next apply it to the determination of the mean value of a *function* of $x + iw$, $y + jw$, $z + kw$; or, in other words, let us investigate the equivalent for your

$$Mf(x + iw,\ y + jw,\ z + kw): \tag{21}$$

by developing this function f according to ascending powers of w, and by substituting, for every product of powers of ijk, its *mean* value determined as above. Writing, as you propose,

$$\frac{d}{dw} = D,\ \frac{d}{dx} = D_1,\ \frac{d}{dy} = D_2,\ \frac{d}{dz} = D_3, \tag{22}$$

we are to calculate and to sum the general term of (21), namely,

$$M\, i^l j^m k^n \times \frac{w^{l+m+n}}{l!\, m!\, n!} D_1^l D_2^m D_3^n f(x, y, z). \tag{23}$$

One only of the exponents, l, m, n, can usefully be *odd*, by properties of the *mean* function, which have been already stated. If *all* be *even*, and if we make

$$l = 2\lambda,\ \ m = 2\mu,\ \ n = 2\nu, \tag{24}$$

the corresponding part of the general term of Mf, namely, the part independent of ijk, is by (15), (18), (19),

$$\frac{(-w^2)^\kappa}{(2\kappa)!} \{\lambda, \mu, \nu\} D_1^{2\lambda} D_2^{2\mu} D_3^{2\nu} f(x, y, z); \tag{25}$$

whereof the sum, relatively to λ, μ, ν, when *their* sum κ is given, is,

$$\frac{(-w^2)^\kappa}{(2\kappa)!} (D_1^2 + D_2^2 + D_3^2)^\kappa f(x, y, z) = \frac{(w\triangleleft)^{2\kappa}}{(2\kappa)!} f(x, y, z), \tag{26}$$

if my signification of $\triangleleft$ be adopted, so that

$$\triangleleft = iD_1 + jD_2 + kD_3; \tag{27}$$

and another summation, performed on (26), with respect to κ, gives, for the part of Mf which is independent of ijk, the expression,

$$\tfrac{1}{2}(e^{w\triangleleft} + e^{-w\triangleleft}) f(x, y, z). \tag{28}$$

"Again, by supposing, in (23),

$$l = 2\lambda + 1,\ \ m = 2\mu,\ \ n = 2\nu, \tag{29}$$

and by attending to (20), we obtain the term,

$$\frac{wiD_1 (-w^2)^\kappa}{(2\kappa+1)!} \{\lambda, \mu, \nu\} D_1^{2\lambda} D_2^{2\mu} D_3^{2\nu} f(x, y, z). \tag{30}$$

Adding the two other general terms correspondent, in which iD_1 is replaced by jD_2 and by kD_3, we change iD_1 to $\triangleleft$; and obtain, by a first summation, the term

$$\frac{(w\triangleleft)^{2\kappa+1}}{(2\kappa+1)!} f(x, y, z); \tag{31}$$

and, by a second summation, we obtain

$$\tfrac{1}{2}\,(e^{w\triangleleft} - e^{-w\triangleleft})\,f(x, y, z), \tag{32}$$

as the *part* of the mean function Mf, which involves expressly ijk. Adding the two parts, (28) and (32), we are conducted finally to the very simple and remarkable transformation of the MEAN FUNCTION Mf, of which the discovery is due to you:

$$Mf(x + iw,\ y + jw,\ z + kz) = e^{w\triangleleft}\,f(x, y, z). \tag{33}$$

In like manner,

$$M\phi\,(x - iw,\ y - jw,\ z - kz) = e^{-w\triangleleft}\,\phi\,(x, y, z). \tag{34}$$

Each of these two means of arbitrary functions, and therefore also their sum, is thus a value of the expression

$$(D^2 - \triangleleft^2)^{-1}0; \tag{35}$$

that is, the partial differential equation,

$$(D^2 + D_1^2 + D_2^2 + D_3^2)\ V = 0, \tag{36}$$

has its general integral, with two arbitrary functions, f and ϕ, expressible as follows:

$$V = Mf(x + iw, y + jw, z + kw) + M\phi\,(x - iw, y - jw, z - kw; \tag{37}$$

which is another of your important results. You remarked that if the second member of the equation (36) had been U, the expression for V would contain the additional term,

$$e^{w\triangleleft}D^{-1}e^{-2w\triangleleft}D^{-1}e^{w\triangleleft}\,U. \tag{38}$$

In fact,

$$D + \triangleleft = e^{-w\triangleleft}De^{w\triangleleft}, \quad D - \triangleleft = e^{w\triangleleft}De^{-w\triangleleft}, \tag{39}$$

and therefore,

$$(D - \triangleleft)^{-1}\,(D + \triangleleft)^{-1} = e^{w\triangleleft}D^{-1}e^{-2w\triangleleft}D^{-1}e^{w\triangleleft}. \tag{40}$$

"Most of this letter is merely a repetition of your remarks, but the analysis employed may perhaps not be in all respects identical with yours: a point on which I shall be glad to be informed.

"I remain faithfully yours,

"WILLIAM ROWAN HAMILTON.

"*The Rev. Charles Graves, D.D.*"

The Rev. Professor Graves, D.D., read the second part of his Paper on the solution of the equation of Laplace's functions.

"In the former part of this Paper I showed that the symbol

$$e^{x(jD_y+kD_z)},$$

or π, as we have denoted it for the sake of brevity, when operating upon $y^m z^n$, has the effect of changing it, if m and n be positive integers, into the

$$\left\{\frac{(m+n)!}{m!\,n!}\right\}^{th} \text{ part of the sum of all the } \frac{(m+n)!}{m!\,n!}$$

differently arranged products, of which each contains m factors equal to $y+jx$, and n equal to $z+kx$. But I reserved the consideration of the cases in which m and n were negative or fractional. In fact, I had ascertained by trial that the theorem just announced must undergo some modification in its statement before it could be extended to the case where m or n was negative; and I was at a loss to conceive what modification could render it applicable in the case where either of the exponents was fractional: the rule given for the formation of a *mean product* seeming of necessity to presume that the exponents were at least integer, if not positive numbers. In the present communication I desire to lay before the Academy the discussion of the reserved cases. In dealing with them I have been led so to modify my definition of a *mean product* as to make it apply where m and n are negative or fractional; at the same time that it coincides with my previous definition in the case where m and n are positive integers: and this has been accomplished by the help of mean products of is, js, and ks, the fundamental theorems respecting which were stated at the end of my former Paper, p. 170. Thus it will be found that we are in possession of a complete and perfectly simple solution of the equation of Laplace's functions:—complete, as involving two arbitrary functions; and simple, as it is

disincumbered from all signs of differentiation or integration to be effected upon them. In this latter respect my solution seems to possess an advantage over those which have been given by Drs. Hargreave and Boole.

"I will now proceed briefly to describe the manner in which I investigate the effect of π upon $y^m z^n$, when m and n are negative or fractional.

"As before, I commence with particular and simple cases, expecting that the results will guide us, by the observation of analogies, to a general conclusion.

"Let us first calculate $\pi\ y^{-1}z^{-1}$. Putting $\rhd$ in place of $jD_2 + kD_3$, we have

$$\rhd\ y^{-1}z^{-1} = -jy^{-2}z^{-1} - ky^{-1}z^{-2},$$
$$\rhd^2\ y^{-1}z^{-1} = -2\,!\,y^{-3}z^{-1} - 2\,!\,y^{-1}z^{-3},$$
$$\rhd^3\ y^{-1}z^{-1} = 3\,!\,jy^{-4}z^{-1} + 2\,!\,ky^{-3}z^{-2} + 2\,!\,jy^{-2}z^{-3} + 3\,!\,ky^{-1}z^{-4},$$
$$\rhd^4\ y^{-1}z^{-1} = 4\,!\,y^{-5}z^{-1} + 2\,.\,2\,!\,2\,!\,y^{-3}z^{-3} + 4\,!\,y^{-1}z^{-5},$$
$$\rhd^5\ y^{-1}z^{-1} = -5\,!\,jy^{-6}z^{-1} - 4\,!\,ky^{-5}z^{-2} - 2\,.\,3\,!\,2\,!\,jy^{-4}z^{-3}$$
$$- 2\,.\,2\,!\,3\,!\,ky^{-3}z^{-4} - 4\,!\,jy^{-2}z^{-5} - 5\,!\,ky^{-1}z^{-6},$$
$$\rhd^6\ y^{-1}z^{-1} = -6\,!\,y^{-7}z^{-1} - 3\,.\,4\,!\,2\,!\,y^{-5}z^{-3} - 3\,.\,2\,!\,4\,!\,y^{-3}z^{-5} - 6\,!\,y^{-1}z^{-7},$$
$$\cdots\cdots = \cdots\cdots\cdots\cdots$$

Hence,

$$\left.\begin{aligned}
\pi\ y^{-1}z^{-1} = y^{-1}z^{-1} &- x\,(jy^{-2}z^{-1} + ky^{-1}z^{-2}) - \frac{x^2}{2\,!}(2\,!\,y^{-3}z^{-1} + 2\,!\,y^{-1}z^{-3}) \\
&+ \frac{x^3}{3\,!}(3\,!\,jy^{-4}z^{-1} + 2\,!\,ky^{-3}z^{-2} + 2\,!\,jy^{-2}z^{-3} + 3\,!\,ky^{-1}z^{-4}) \\
&+ \frac{x^4}{4\,!}(4\,!\,y^{-5}z^{-1} + 2\,.\,2\,!\,2\,!\,y^{-3}z^{-3} + 4\,!\,y^{-1}z^{-5}) \\
&- \frac{x^5}{5\,!}(5\,!\,jy^{-6}z^{-1} + 4\,!\,ky^{-5}z^{-2} + 2\,.\,3\,!\,2\,!\,jy^{-4}z^{-3} \\
&\qquad + 2\,.\,2\,!\,3\,!\,ky^{-3}z^{-4} + 4\,!\,jy^{-2}z^{-5} + 5\,!\,ky^{-1}z^{-6}) \\
&- \frac{x^6}{6\,!}(6\,!\,y^{-7}z^{-1} + 3\,.\,4\,!\,2\,!\,y^{-5}z^{-3} + 3\,.\,2\,!\,4\,!\,y^{-3}z^{-5} + 6\,!\,y^{-1}z^{-7}) \\
&+ \&c. \ldots\ldots
\end{aligned}\right\}(A)$$

" Now let us compare this with

$$\tfrac{1}{2}\{(y+jx)^{-1}(z+kx)^{-1}+(z+kx)^{-1}(y+jx)^{-1}\},$$

to which the analogy of example (2) in my former Paper, p. 163, might lead us to expect to find it equal.

" Developing by the binomial theorem, we have

$$\left.\begin{aligned}(y+jx)^{-1}(z+kx)^{-1} = y^{-1}z^{-1} &- x\,(jy^{-2}z^{-1}+ky^{-1}z^{-2})\\ &- x^2\,(y^{-3}z^{-1}-iy^{-2}z^{-2}+y^{-1}z^{-3})\\ &+ x^3\,(jy^{-4}z^{-1}+ky^{-3}z^{-2}+jy^{-2}z^{-3}+ky^{-1}z^{-4})\\ &+ x^4\,(y^{-5}z^{-1}-iy^{-4}z^{-2}+y^{-3}z^{-3}-iy^{-2}z^{-4}+y^{-1}z^{-5})\\ &- x^5\,(jy^{-6}z^{-1}+ky^{-5}z^{-2}+jy^{-4}z^{-3}+ky^{-3}z^{-4}+jy^{-2}z^{-5}\\ &\qquad +ky^{-1}z^{-6})\\ &- x^6\,(y^{-7}z^{-1}-iy^{-6}z^{-2}+y^{-5}z^{-3}-iy^{-4}z^{-4}+y^{-3}z^{-5}\\ &\qquad -iy^{-2}z^{-6}+y^{-1}z^{-7})\\ &+ \&c. \ldots\ldots\end{aligned}\right\}\text{(B)}$$

And $(z+kx)^{-1}(y+jx)^{-1}$ differs from this only in the signs of the terms containing i. Consequently, the development of

$$\tfrac{1}{2}\{y+jx)^{-1}(z+kx)^{-1}+(z+kx)^{-1}(y+jx)^{-1}\}$$

differs from the series just given only by the omission of these terms. But this omission will not make it agree with the expression already found for $\pi\ y^{-1}z^{-1}$.

" The discrepancy first shows itself in the numerical coefficients of the terms

$$x^3y^{-3}z^{-2},\ x^3y^{-2}z^{-3},\ \text{and}\ x^4y^{-3}z^{-3}.$$

In the former development (A) these coefficients are all $=\frac{1}{3}$. In the latter (B) to unity.

" Again, the coefficients of $x^5y^{-4}z^{-3}$, $x^5y^{-3}z^{-4}$, $x^6y^{-2}z^{-6}$, $x^6y^{-6}z^{-2}$, $x^6y^{-5}z^{-3}$, and $x^6y^{-3}z^{-5}$ are all equal in (A) to $\frac{1}{3}$, in (B) to unity. It is needless to proceed further in the comparison of the two developments.

" As regards the first instance of disagreement, viz. that between the coefficients in the two series of the terms $x^3y^{-3}z^{-2}$ and $x^3y^{-2}z^{-3}$; it must be observed that in (B) these terms have

respectively the imaginary coefficients k and j; or, more exactly, after the restoration of the powers of j and k suppressed in virtue of the equations $j^2 = k^2 = -1$; the imaginary coefficients $-j^2k$ and $-k^2j$. Now, by the theorems in p. 170, the mean value of the product of two j s and one k is,

$$\frac{2!\,1}{3!}\,\Sigma(2,1) = \frac{2!\,1}{3!}(-1)k = -\frac{1}{3}k\,;$$

and the mean value of the product of two k s and one j is $-\frac{1}{3}j$. So that, so far as concerns the terms $x^3y^{-2}z^{-1}$ and $x^3y^{-1}z^{-2}$, the difference between the two developments consists in this: that in (B) these terms are multiplied by ordinary products, but in (A) by mean products of j s and k s.

"The next discrepancy noticeable is in the coefficient of $x^4y^{-2}z^{-2}$. In (B) this is j^2k^2, if the suppressed powers of j and k be restored. Now the mean value of the product of two j s and two k s, by the formulæ of p. 170, is

$$\frac{2!\,2!}{4!}\cdot\frac{2!}{1\,.\,1} = \frac{1}{3}.$$

Here again we find a mean product of j s and k s in (A), corresponding to an ordinary product in (B).

"The next discrepancy occurs in the case of the coefficients of $x^5y^{-4}z^{-3}$ and $x^5y^{-3}z^{-4}$. In (B) these are $-j^3k^2$, and $-j^2k^3$, if we restore the suppressed powers of j and k. Now the mean value of the product of three j s and two k s is,

$$\frac{3!\,2!}{5!}\cdot\frac{2!}{1\,.\,1}j, \text{ or } \frac{1}{5}j\,;$$

and the mean value of the product of two j s and three k s is $\frac{1}{5}k$. Here again, therefore, we find mean values of products of j s and k s in (A), corresponding to ordinary products in (B).

"Let us next consider the coefficients of $x^5y^{-5}z^{-2}$ and $x^5y^{-2}z^{-5}$. In (B) they are $-j^4k$ and $-jk^4$: but the mean values of pro-

ducts of one j and four k s, or four j s and one k, are respectively

$$\frac{4!\,1}{5!}j \text{ and } \frac{4!\,1}{5!}k, \text{ or } \frac{1}{5}j \text{ and } \frac{1}{5}k,$$

so that here likewise we find mean products in (A) standing in place of ordinary products in (B).

"Lastly, the coefficients of $x^6y^{-5}z^{-3}$, and $x^6y^{-3}z^{-5}$ in (B) are j^4k^2 and j^2k^4. Now the mean value of the product of four j s and two k s, or of two j s and four k s, is $= -\frac{1}{3}$, which is the coefficient belonging to $x^6y^{-5}z^{-3}$ and $x^6y^{-3}z^{-5}$ in (A).

"It is, moreover, to be observed that all the terms which disappear out of (B) have coefficients like jk^3, the exponents of both j and k being odd numbers. Now the mean value of a product containing odd numbers both of j s and k s has been proved equal to 0.

"It is also deserving of remark, that where the developments coincide, the mean values and the ordinary products are equal. In fact, these coincidences occur in the case of the first and last terms in each group of terms multiplied by the same power of x; and in their coefficients j s and k s are not combined.

"So far, then, as our examination has extended, the discrepancy between the developments (A) and (B) consists in this, that mean values of products of j s and k s stand in the former in place of ordinary products occurring in the latter.

"The careful examination of this one example led me to suspect, that when m and n are integers, the difference between the expression $\pi\ y^{-m}z^{-n}$ and the ordinary algebraic development of $(y + jx)^{-m}\ (z + kx)^{-n}$, effected without any regard to the properties of j and k, consists merely in this, that mean products of j s and k s take the place in the former of ordinary products occurring in the latter. To test this hypothesis let us try another simple example, in which y and z are not symmetrically involved. Let us calculate $\pi\ yz^{-1}$. We shall have then

$$\triangleright\ yz^{-1} = jz^{-1} - kyz^{-2},$$
$$\triangleright^2\ yz^{-1} = -2!\,yz^{-3},$$
$$\triangleright^3\ yz^{-1} = -2!\,jz^{-3} + 3!\,kyz^{-4},$$
$$\triangleright^4\ yz^{-1} = 4!\,yz^{-5},$$
$$\triangleright^5\ yz^{-1} = 4!\,jz^{-5} - 5!\,kyz^{-6},$$
$$\triangleright^6\ yz^{-1} = -6!\,yz^{-7},$$
$$\cdot\ \cdot\ \cdot\ \cdot = \cdot\ \cdot\ \cdot\ \cdot\ \cdot$$

'e find

$$\begin{aligned} z^{-1} &+ x\,(jz^{-1} - kyz^{-2}) - x^2yz^{-3} - \frac{x^3}{3!}\,(2!\,jz^{-3} - 3!\,kyz^{-4}) \\ &+ x^4yz^{-5} + \frac{x^5}{5!}\,(4!\,jz^{-5} - 5!\,kyz^{-6}) - x^6yz^{-7} - \&c. \end{aligned} \qquad \text{(A)}$$

us compare this with the development of

$$(y + jx)\ (z + kx)^{-1}.$$

ıg by the binomial theorem, and preserving the ' j and k, when both appear in the same coefficient,

$$\begin{aligned} z + kx)^{-1} = yz^{-1} &+ x\,(jz^{-1} - kyz^{-2}) - x^2\,(jkz^{-2} + yz^{-3}) \\ &+ x^3\,(jk^2z^{-3} + kyz^{-4}) - x^4\,(jk^3z^{-4} - yz^{-5}) \\ &+ x^5\,(jk^4z^{-5} - kyz^{-6}) - x^6\,(jk^5z^{-6} + yz^{-7})\ .\ .\ . \\ &+ \&c.\ .\ .\ .\ .\ . \end{aligned} \qquad \text{(B)}$$

'epancies between the developments (A) and (B) are ı, but all of them are of the same kind. In the first terms x^2z^{-2}, x^4z^{-4}, x^6z^{-6}, &c., do not appear in (A). ey have the coefficients jk, jk^3, jk^5, &c. But the *mean* such products of j and k are equal to zero.

ain, the mean value of the product of one j and 2ν

$\frac{\quad}{+1}\,(-1)^{\nu}$. Hence the coefficients in the two develop- x^3z^{-3}, x^5z^{-5}, &c., differ just in this: that in (A) they . products, in (B) ordinary products of j s and k s. ıppears, as we anticipated, that if we substitute mean of j s and k s for ordinary products throughout the

entire development of $(y + jx)\ (z + kx)^{-1}$, we shall produce the development of $\pi\ yz^{-1}$.

"Without stopping to consider the case where m or n is fractional, we may now proceed to establish the mode of interpreting $\pi\ y^m z^n$, whatever be the nature of m and n.

"The coefficient of $x^{\mu+\nu} y^{m-\mu} z^{n-\nu}$ in the development of $\pi\ y^m z^n$, is equal to the coefficient of $x_{\mu}{}^{+}{}_{\nu} D_2^{\mu} D_3^{\nu}$ in the development of $e^{x(jD_2+kD_3)}$, multiplied by

$$m(m-1)\ldots\ldots(m-\mu+1)\,n(n-1)\ldots\ldots(n-\nu+1).$$

But, in the development of the exponential, $D_2^{\mu} D_3^{\nu}$ occurs only in the term

$$\frac{x^{\mu+\nu}(jD_2 + kD_3)^{\mu+\nu}}{(\mu+\nu)\,!},$$

and there has for its coefficient

$$\frac{\Sigma\,(\mu,\ \nu)}{(\mu+\nu)\,!}.$$

Consequently, the coefficient sought is

$$\frac{m(m-1)\ldots\ldots(m-\mu+1)\,n(n-1)\ldots\ldots(n-\nu+1)}{(\mu+\nu)\,!}\,\Sigma\,(\mu,\ \nu).$$

"But again, if we develop $(y + jx)^m\ (z + kx)^n$ in the manner already mentioned, that is to say, preserving all the powers of j and k, and afterwards substituting mean products for ordinary products of these imaginaries; the coefficient of $x^{\mu+\nu} y^{m-\mu} z^{n-\nu}$ is plainly

$$\frac{m(m-1)\ldots\ldots(m-\mu+1)\,n(n-1)\ldots\ldots(n-\nu+1)}{\mu\,!\ \nu\,!}\,M(\overset{\mu}{j},\ \overset{\nu}{k}),$$

or, since

$$M(\overset{\mu}{j},\ \overset{\nu}{k}) = \frac{\mu\,!\ \nu\,!}{(\mu+\nu)\,!}\,\Sigma\,(\mu,\ \nu),$$

to

$$\frac{m(m-1)\ldots\ldots(m-\mu+1)\,n(n-1)\ldots\ldots(n-\nu+1)}{(\mu+\nu)\,!}\,\Sigma\,(\mu,\ \nu).$$

Thus, we have demonstrated generally that the expression

$$e^{x(jD_2+kD_3)} f(y, z),$$

to be interpreted as follows:—

"Substitute $y + jx$ for y, and $z + kx$ for z in $f(y, z)$; taking ıre to leave all powers of j and k in evidence, and then relace all the products of j s and k s, obtained in this way by *ıean products* of those imaginaries.

"Reasoning and processes in all respects similar lead to ıe conclusion that the effect of the symbol

$$e^{w(iD_1+jD_2+kD_3)}$$

pon any function whatsoever of x, y, and z will be to change into the same function, *in its mean state*, of $x + iw$, $y + jw$, nd $z + kw$. By this it is to be understood, that after this hange of the variables has been made, and the development ffected as if i, j, and k were ordinary algebraic quantities, *ıean values* of products of the imaginaries are to be substiuted for ordinary ones.

"Reverting now to the solutions of the differential equaions noticed in the first part of this Paper, p. 168, we see hat they hold good, without any limitation of the nature of he arbitrary functions, provided we modify, or rather perfect, ur conception of the *mean state* of a function in the manner ust described.

"Our new definition of a mean product, or of a mean funcion, coincides with that given at p. 166, in the case where m ınd n are positive integers; and it includes the cases where m ınd n are negative or fractional, to which the original definiion of a mean product is inapplicable.

"If it should prove that the solution of Laplace's equation ıow attained to, viz.:

$$V = Mf_1(y + jx, z + kx) + Mf_2(y - jx, z - kx),$$

s something more than a mathematical curiosity, and answers he demands of physical inquiry, we shall have reason to reoice not only in the fruits of that particular discovery, but

also in the anticipation that other important steps in mathematics may be made by the help of Sir William Hamilton's imaginaries. I hope before long to be able to furnish the Academy with some reply to the questions here suggested.

Rev. Samuel Haughton made some observations on the Rev. Dr. Graves' paper.

Rev. Humphrey Lloyd, D.D., read a further communication "on the magnetic influence of the Moon."

The President and Rev. Samuel Haughton made some remarks, eliciting explanations from Dr. Lloyd as to the analogy of the magnetic phenomena described by him, to corresponding phenomena connected with the tides.

In the absence of Edward J. Cooper, Esq., his Paper on "Ecliptic Catalogues" was read by the Secretary:—

"Having completed the catalogues of ecliptic stars observed here during six years, it occurred to me to employ a few holidays, which I gave myself after the publication of our third volume, in examining some of the general results deducible from them, and comparing these results with concurrent meteorological phenomena. My object was to ascertain the soundness of a preconceived opinion, that the records of the state of the weather are useless as a guide in estimating the most favourable periods of the year for astronomical observations. To the investigation I added a search for any striking facts that might appear during the course of the work, in which Mr. Graham has been the principal performer, in the capacity of an indefatigable observer.

"The mode of proceeding which we originally adopted was, as is stated in the Introduction to the first volume of 'Ecliptic Stars,' one which we considered the most likely to

possess the two essential conditions of rapidity and sufficient accuracy. It would require some little labour and time to ascertain from the published volumes the effectual manner in which the former of these conditions has been carried out. This, however, is easily established from the nightly noted observations. On six occasions the nightly number of stars observed approached 500; on three occasions it exceeded 500, exclusively of one, when it approached 900; another 1200; and at last, on January 17th of the present year, no fewer than 1387 were secured. The two last, and one of the first cited, are not yet published.

"With reference to the second condition, which, *primâ facie*, might appear unfavourably affected by the success of the first, it will be seen, by reference to the Introduction already alluded to, that the probable error of an observation in right ascension of $0^{s}\cdot288$, and in declination of $4''\cdot27$, was the result deduced from 1345 known stars. But this statement does not fairly represent the accuracy of the observations; for, be it remembered, that it originates in a comparison of previously determined stars, as observed and used by us for the reduction of the places of those published in our volumes, and their catalogued places, and with the result is mixed up the errors of those catalogues. Were this not the case, our probable error in right ascension must necessarily have appeared considerably less than in declination: the right ascension being obtained from the *mean* of two observations; the declination from their *difference*. It is fair, then, to assume, that the second condition has been fulfilled.

"The Tables on pp. 196, 197, will show, as expected, that meteorological records would furnish no data from which a practical astronomer could select a time for his visit to this western station with any certainty of securing clear nights for observation. Were he to choose the month of May in consequence of its greatest freedom from rain, he would find it low in the order of productiveness; or November as the least variable, still the

Table I.

Month.	1848.				[illegible]				1850.				1851.	
	C.	K.	D.	Total.	C.	K.	D.	Total.	C.	K.	D.	Total.	C.	K.
July,	...	...	...	...	358	41	38	432	86	8	7	96	374	[illegible]
August,	949	[illegible]	67	1065	5	19	34	58	183	18	16	217	1205	[illegible]
September,	734	64	47	844	1151	92	168	1411	1076	98	201	1375	1137	[illegible]
October,	1009	198	180	1387	864	101	95	1060	637	88	62	782	[illegible]	[illegible]
November,	470	54	56	580	209	34	11	254	280	85	23	288	914	[illegible]
December,	1534	222	7	1763	260	31	[illegible]	321	1131	117	46	1294	912	[illegible]
January,	...	...	...	...	959	[illegible]	20	1143	676	101	[illegible]	837	1520	[illegible]
February,	...	...	...	...	[illegible]	0	0	0	47	7	2	56	886	91
March,	...	...	...	...	502	69	37	608	1840	214	89	1593	602	77
April,	...	...	...	...	0	0	0	0	249	33	[illegible]	290	850	77
May,	...	...	...	...	0	0	0	0	172	26	9	207	404	18
June,	...	...	...	...	48	3	4	55	0	0	0	0	182	[illegible]

Table II.

Months in the Order of absolute Productiveness.	Stars.	Average.
September, averaging	1215	
April, ,,	1171	
March, ,,	1112	
December, ,,	1003	
January, ,,	898	
October, ,,	818	
November, ,,	699	789
February, ,,	645	
May, ,,	614	
August, ,,	608	
July, ,,	544	
June, ,,	141	

Table III.

Months in the Order of least Rain.	Inches.
May,	1·940
March,	2·069
September,	2·343
April,	2·519
February,	2·852
June,	3·231
December,	3·246
July,	[illegible]
November,	3·941
October,	4·253
August,	4·403
January,	4·573

Table I.—*continued.*

onth.	1852.				1853.				1854.				Total for six years.	Annual Average.
	C.	E.	D.	Total.	C.	E.	D.	Total.	C.	E.	D.	Total.		
y. . . .	720	65	91	876	85	32	6	123	855	224	120	1199	3263	544
gust, . .	318	62	52	432	197	49	86	332	. .	. .	. .	. .	3646	608
ember, .	766	120	123	1009	761	139	225	1125	. .	. .	. .	. .	7289	1215
ber, . .	451	83	62	596	141	28	26	195	. .	. .	. .	. .	4907	818
ember, .	605	96	54	755	926	142	142	1210	. .	. .	. .	. .	4192	699
ember, .	819	111	64	994	397	65	45	507	. .	. .	. .	. .	6020	1003
uary, . .	580	82	45	707	651	[illegible]	66	802	33	17	10	60	5386	898
ruary, .	[illegible]	189	44	1218	1081	221	137	1439	1078	188	66	1332	5071	845
rch, . .	1370	194	82	1646	468	75	80	623	1180	221	92	1493	6673	1112
ril, . . .	1853	232	208	2293	988	166	172	1326	1544	242	320	2106	7028	1171
ay, . . .	254	20	22	296	1489	294	88	1871	727	118	60	905	3726	621
ne, . . .	0	0	0	0	322	108	71	501	110	30	6	146	847	141
													58048	9675

Table IV.

Hours dark enough for Observations.	
ember, ...	258
uary, ...	249
vember, ...	233
ober, ...	207
ruary, ...	200
rch, ...	181
tember, ...	159
ril, ...	129
gust, ...	118
y, ...	75
y, ...	57
ne, ...	29

Table V.

Months in the Order of Darkness.	Stars per Hour.	Average.
December, ...	3·9	5·8 nearly
January, ...	3·6	
November, ...	3·0	
October, ...	3·9	
February, ...	4·2	
March, ...	6·1	
September, ...	7·6	
April, ...	9·1	
August, ...	5·4	
May, ...	8·8	
July, ...	9·5	
June, ...	4·9	

numbers of stars obtained is below the average of the year. Lastly, were he to select December as the month producing the greatest number of hours dark enough for his purpose, he would again be foiled, the number of stars obtained per hour of darkness in this month being considerably below the average of the year. It will be perceived that September has proved to be the most productive *absolutely*, although three other months stand higher in horary results. At this season there is little to contend with, excepting clouds. The nights are long enough for the strength of the observer, and there is no frost to coat the object-glass. The latter is a serious obstacle in the colder months, and especially in this Observatory, where the large equatorial is completely exposed; and the object-glass too heavy to be frequently removed with prudence.

"In my general examination of the zones, planets were sought for, but only two detected:—Neptune, in vol. I., page 196, in right ascension, $22^h\ 27^m\ 26^s$; and Melpomene, in vol. III., page 177, in right ascension, $8^h\ 6^m\ 34^s$. The paucity of observations of planets found in the zones may be thus accounted for. The telescope is almost invariably used near the meridian, and, the time of a planet's passage being known, the zone-observing was frequently abandoned to obtain the most accurate place of the planet with the meridian circle. Facts indicative of an unknown planet were always noted in forming the catalogue, and many places have been subsequently examined with the meridian circle. Hitherto the only results have been notes of two or three missing stars, on which we cannot at this moment lay our hands. A comparison by Mr. Graham of a portion of his maps, in course of execution, with the heavens, gave the following stars as missing:—

Vol. I.,	page	73, . . .	4^h	18^m	24^s
,,	,,	107, . . .	20	18	9
,,	,,	182, . . .	20	3	42
,,	,,	,, . . .	20	7	19
Vol. II.,	page	8, . . .	4	54	9
,,	,,	92, . . .	20	6	42

The President observed that the stars contemplated in Mr. Cooper's Paper were many of them below the tenth magnitude, and that, therefore, the conditions of clearness, &c., of atmosphere required for such observations would not be applicable to the mere ordinary work of observatories.

Rev. Charles Graves, D.D., read a Paper containing an account of certain notes in the Ogham character, occurring in the margin of an ancient manuscript of Priscian, in the Library of St. Gall.

March 16th, 1855. (Stated Meeting.)

HOMAS ROMNEY ROBINSON, D. D., President, in the Chair.

HE Secretary of the Council read the following Report from e Council:—

REPORT.

In presenting their Annual Report for the Session of 1854–5, e Council have to congratulate the Academy on increased activity the publication of their Transactions.

The Fifth Part (Science) of the Twenty-Second Volume has been ently published, and is now ready for distribution among the mbers.

The Sixth Part (Polite Literature) is in a very advanced state, the Council hope to be able to announce its publication in a y short time.

The First Part (Science) of the Twenty-Third Volume is also tially printed, and the Second Part (Polite Literature) has been menced.

Several interesting papers have been, during the past year, communicated to the Academy.

In Pure and Mixed Mathematics we have had communications m Sir William R. Hamilton on "Quaternions;" and from Pro-sor Graves on "The Principles which regulate the Interchange Symbols," and on "The Equation of Laplace's Functions;" and m Mr. Rennie on "The Use of the Hygrometer in the Barome-e Measurement of Heights." The President has given us a paper "The Electro Magnet."

In the Sciences of Observation and Experiment, Professor ughton has given us a paper on "The Reflexion of Plane Pola-ed Light from the Surface of Transparent Bodies," and on The Optical Properties of the Micas contained in the Dublin, Wick-w, and Carlow Granites." We have also had communications m Dr. Lloyd on "The Magnetic Influence of the Moon;" from

Mr. Galbraith on "The Chemical Composition of the Felspar found in the Dublin and Wicklow Granites;" from Dr. Allman on "The Existence of a true Medusoid Structure in the Male Gemmæ of Hydra," and on "Aphanizomenon Flos-Aquæ;" from Dr. Harvey on "The Marine Botany of Western Australia;" and from Professor Downing, on "The Draining of the Haarlem Lake;" with several others.

In Polite Literature, Dr. Hincks has contributed a paper on "The Chronology of the Twenty-Sixth Egyptian Dynasty and of the Commencement of the Twenty-Seventh." The same author has also given us a paper on "Assyrian Mythology." Professor Graves has made a communication on "The Comparison of Adjectives in the Ancient Irish Language."

In Antiquities, Mr. Charles Mac Donnell has made a communication relative to the MSS. of the celebrated John Colgan, preserved at St. Isidore's, Rome. We have also received a communication from Dr. Ball, on "An Attempt to prove the Age of the large Bronze Trumpets in the Museum."

The Proceedings of the Academy have appeared with great regularity.

The Council regret that the progress in the preparation of a Catalogue of the Museum has not been as rapid as could be desired. A Report from the Committee appointed to superintend this work is here subjoined.

During the past year some important organic changes in the constitution of the Council have been carried into effect.

The duties heretofore discharged by the Committee of Publication have been delegated to the Council at large, who are also empowered to obtain the assistance of any other Members of the Academy, whose acquaintance with the subject of any one or more of the papers submitted for publication may enable them to give to the Council valuable suggestions in the discharge of this important task. This change will probably be considered to be calculated to add to the efficiency of the publishing department.

At the Stated Meeting held in March last, the Academy expressed their opinion that it would be desirable to secure a greater amount of rotation among the Members of the Council than exists at present. In accordance with this opinion, the Council submitted to the

Academy, in November last, a By-Law, by which it was declared to be expedient that, with the exception of the Officers of the Academy, the senior Members of each Committee should be removed in each year. This By-Law, which, in conformity with the Charter, is expressed merely as a recommendation to the Members in the disposal of their votes, was passed by the Academy, and comes into operation on this evening. Should the Members act in conformity with it, a minimum of three vacancies in each year will be secured.

An important addition has been made to our Museum during the past year, by the purchase of Mr. Murray's Collection of Antiquities.

The following purchases of Antiquities have also been made by the Council out of the sum placed at their disposal by the Academy for that purpose:—

1. A highly ornamented spear-head: from Mr. M. Daly.

2. Several bronze and iron antiquities found in the neighbourhood of Strokestown: from Mrs. Conry.

3. An earthen vessel; a bronze cross; a handle of ancient skillet, highly ornamented; a prick spur; a collection of small fibulæ; a bronze mace and large ring: from Mr. J. Underwood.

4. A large earthen jar or jug: from the Rev. Mr. Archbold.

5. Two episcopal seals, one belonging to the late President of the Academy, Right Rev. Dr. Brinkley: from Mrs. Flood.

6. A miscellaneous collection of Antiquities: from Mr. P. Fegan.

7. A large silver fibula: bought by Mr. J. F. Jones at Mr. Gardner's auction.

8. A peculiarly beautiful silver fibula: from Mr. Bindon.

9. A remarkably large and perfect bronze trumpet: from Mr. George Du Noyer.

10. A silver pommel of a sword, handsomely inlaid with fine wire filigree: from Mr. Murray.

11. A peculiarly fine bronze pin, with a cone-shaped head; a small bronze cross or ornament; a peculiarly shaped celt, and a private seal, found in the excavations in College-green, have also been bought from different individuals.

The Council has also purchased a collection of plaster casts taken from the ancient stone crosses in the Isle of Man, from the Rev. J. Cumming.

A subscription has been opened for the purchase of a portion of the collection of gold ornaments recently discovered in the county of Clare, and exhibited at the Meeting of the Academy held on the 26th June.

During the past year, ten new Members have been added to the Academy. Their names are:—

Cheyne Brady, Esq.	James Higgins Owen, Esq.
Sir Bernard Burke.	Edward Senior, Esq.
Parke Neville, Esq.	Alexander Carte, M. D.
Rt. Hon. Francis Blackburne.	Rev. Ogle William Moore.
Richard G. H. Butcher, Esq.	Rev. Robt. Carmichael, F.T.C.D.

During the same period two Honorary Members and eleven ordinary Members have been lost to us by death. The names of the Honorary Members are:—

Carl Friedrich Gauss, and Robert Jameson, Esq.

The names of the ordinary Members deceased within the same period are:—

1. John Edward Butler, Esq.; elected 11th April, 1853: died 23rd July, 1854.
2. C. T. Webber, Esq.; elected 9th April, 1838: died 25th March, 1854.
3. Roger C. Walker, Esq.; elected 24th June, 1833: died 6th September, 1854.
4. Rev. James Reid; elected 12th April, 1841: died 12th September, 1854.
5. Oliver Sproule, Esq.; elected 10th May, 1841: died 3rd September, 1854.
6. Robert Forster, Esq.; elected 13th January, 1845: died 2nd June, 1854.
7. William Edington, Esq.; elected 10th March, 1835: died 13th October, 1854.
8. Wyndham Goold, M.P.; elected 9th June, 1845: died 27th November, 1854.
9. The Earl of Leitrim; elected 7th July, 1802: died 2nd January, 1855.

10. Maurice Collis, Esq.; elected 12th February, 1849: died 15th January, 1855.

11. Bindon Blood, Esq.; elected 16th March, 1802: died 27th January, 1855.

It was Resolved,—That the Report of the Council be adopted, and printed in the Proceedings.

The Rev. Dr. Todd read the following Report from the Committee appointed by the Council to prepare a Catalogue of the Museum:—

REPORT.

The Committee was appointed on the 18th March, 1852, by the following Resolution of Council:—

"That in consequence of the resignation of Dr. Petrie as proved by his Letter addressed to the Council, the following Gentlemen,

The Earl of Dunraven,	Aquilla Smith, M. D.,
Rev. J. H. Todd, D. D.,	Major T. A. Larcom, R. E.,

be appointed a Committee to carry out the plan already agreed upon by the Academy for the preparation and publication of the Catalogue."

On the 19th April, 1852, the Committee presented to the Council the following Report:—

"The Resolution of the Council, directing a Catalogue of the Museum to be prepared, distinctly specifies three objects to be kept in view:—

"1st. An accurate list of everything in the Museum.

"2nd. Such a list as may be a guarantee for the safety of the articles.

"3rd. A Descriptive Catalogue, for the use of visiters.

"It is the opinion of the Committee, that the first of these objects would be attained by continuing the Register commenced some years ago in connexion with the Pictorial Catalogue, which was, however, discontinued about two years since.

"They would, therefore, recommend that this list be continued, and that the Pictorial Catalogue be also completed up to the present time, by which the second of the foregoing objects would be in a

great measure attained, especially if weights and measurements were added to each object portrayed.

"For the purpose it will be necessary that a sum not exceeding £50 be placed at the disposal of the Committee.

"Whilst the Register and Pictorial Catalogue are in course of completion, as above recommended, the Committee will take the necessary steps for a permanent classification of the Museum, with a view to the preparation of the Descriptive Catalogue."

On the 7th of July, 1852, the Committee held a meeting, at which Mr. Clibborn reported that 5373 articles had been already entered in the Number Book or Register of the Museum, and that about 500 articles still remained to be entered, which it was then thought could have been done before the ensuing Session of the Academy.

At the same meeting scales and weights were ordered to be purchased, and the whole of the gold ornaments were afterwards accurately weighed by Dr. Aquilla Smith and Mr. Clibborn, previous to their being exhibited at the Dublin Exhibition.

Whilst the Museum remained at the Exhibition nothing could of course be done, and since its return the first care was to place it in the new room now prepared for it; which necessarily took up much of Mr. Clibborn's time and attention, and prevented his completing the Register as was at first proposed.

After the return of the Museum the Committee inspected the numerical Register, and instructed Mr. Clibborn to have the columns headed *weights*, and *where procured*, filled up.

Much difficulty, however, has been found in completing these entries. Mr. Clibborn reports that many of the numbers formerly pasted on the articles have come off, owing to the dampness of the new rooms, and that this accident has necessarily occasioned much difficulty and delay.

The weights of all the gold and most of the silver articles, however, have been inserted in the Register.

The numbers have also been attached to the drawings of all the gold articles in the Pictorial Catalogue, referring to the corresponding numbers in the Register.

The Committee must, therefore, report to the Council, that it is now impossible to make any further progress in the Descriptive

Catalogue until the Museum has been more exactly arranged, and the articles fixed in permanent places. The crypt under the Library, which is intended for the reception of the larger and coarser articles, has been but just completed, and the glass cases, which are to stand on the railing round the gallery, have not yet been received. The permanent arrangement, therefore, cannot as yet be satisfactorily commenced; but the Committee recommend the immediate attention of the Council to this subject.

With respect to the Pictorial Catalogue, the Committee after much consideration resolved, that the recent improvement in photography, especially the collodion process, offered the most advantageous and economical means of obtaining accurate representations of the principal articles of the Museum. An excellent apparatus was therefore ordered, and several beautiful photographs were taken by Mr. Tennison, who kindly offered his services to carry out this object.

This work, however, has also been stopped by the want of a suitable glass chamber for conducting the practical operations of the photographic processes. This chamber, it was hoped, might have been erected at a small expense, but on obtaining estimates it was found that the cost would be much greater than was at first anticipated. The Committee, however, have reason to suppose that this deficiency will shortly be supplied.

The Ballot for the annual election having closed, the following gentlemen were declared to have been elected Officers and Council for the ensuing year:—

President.—Rev. Thomas R. Robinson, D. D.
Treasurer.—Robert Ball, LL. D.
Secretary to the Academy.—Rev. J. H. Todd.
Secretary to the Council.—Rev. J. H. Jellett, A. M.
Secretary of Foreign Correspondence.—Rev. S. Butcher, D. D.
Librarian.—Rev. William H. Drummond, D. D.
Clerk and Assistant Librarian.—Edward Clibborn.

Committee of Science.

Robert Ball, LL. D.; Sir Robert Kane, M. D.; George J. Allman, M. D.; Sir W. R. Hamilton, LL. D.; Rev. Samuel Haughton, A. M.; Rev. Humphrey Lloyd, D. D.; Rev. George Salmon, A. M.

Committee of Polite Literature.

Rev. W. H. Drummond, D. D.; Rev. Charles Graves, D. D.; John Anster, LL. D.; Rev. S. Butcher, D. D.; D. P. Starkey, Esq., A. M.; Rev. J. H. Jellett, A. M.; John F. Waller, LL. D.

Committee of Antiquities.

George Petrie, LL. D.; Rev. James H. Todd, D. D.; Aquilla Smith, M. D.; Earl of Dunraven; Colonel T. A. Larcom; Lord Talbot de Malahide; William R. Wilde, Esq.

The President nominated, under his hand and seal, the following Vice-Presidents:—Lieut-Col. Larcom, R. E.; George Petrie, LL. D.; Rev. Charles Graves, D. D.; Sir Robert Kane, M. D.

MONDAY, APRIL 9TH, 1855.

LIEUT-COL. LARCOM, F. R. S., VICE-PRESIDENT, in the Chair.

JOHN T. GILBERT, Esq.; John Edward Walsh, LL. D.; and John Ringland, Esq., were elected Members of the Academy.

On the recommendation of the Council, it was

I. RESOLVED,—That the Resolutions adopted by the Academy on the 30th of November, 1854, are not intended to limit the right of the Members of the Academy to vote for any name appearing on the Balloting List prepared by the Council; but to record the deliberate opinion of the Academy, that it is expedient that a Member of each Committee should be removed annually, in the manner which those Resolutions recommend.

II. That the Treasurer be authorized to sell out of the Funds a sum not exceeding £500 of Stock, in order to meet the expenditure of moving into the present house.

Professor Graves, D. D., read the second part of his Paper on the Ogham Notes in the St. Gall MS. of Priscian.

"In the Library of St. Gall in Switzerland is preserved a manuscript of Priscian, written in an Irish hand and full of glosses, both interlinear and marginal, in the Irish language. Several of the marginal glosses are in the Ogham character, and on account of their great antiquity deserve a special notice. I had been for some time aware of their existence, and my curiosity respecting them had been excited by seeing a *facsimile* of one of them in Dr. Keller's Memoir on the Irish Manuscripts extant in Swiss Libraries. But it was not till I had been put in possession of trustworthy copies of them, made by Dr. Todd, that I thought it worth my while to attempt to

decipher them, or to speculate concerning their age. For the conduct of this inquiry I found abundant materials in the *Grammatica Celtica* of Professor Zeuss. In his introduction he has described the MS. minutely; in the body of his work he has quoted a vast number of the glosses; and in an Appendix he has exhibited a considerable portion of the text of the MS., together with all the interlinear glosses pertaining to it. He has, moreover, given the readings of the simpler Oghams, and to some extent discussed the question relative to the date of the MS. On this lattter point, however, he has not arrived at definite conclusions. He seems rather to incline to the notion, that the MS. was written by an Irish scribe on the Continent; and he does not dispute the dictum of Haenel, who refers it to the *eighth* century.

"Before I proceed to read and translate the Oghams themselves, I must state that they form a part of the general body of the glosses; they were written at the same time, by the same person, and with the same objects. The glossographer, as was usual with Irish scribes, made occasional memoranda in the margin, noting how his work progressed, and occasionally referring to circumstances which occurred as he was actually writing. A few of these relate to the nature of the text, as, *Sude qui legat difficilis est ista pagina.* Many are ejaculations, or prayers for a blessing on the scribe's work, as *Fave Brigita; Sancta Brigita adjuva scriptorem istius artis* (the *Ars Grammatica* of Priscian); *In nomine Almi Patricii; In nomine Sancti Diormitii.* The saints invoked in this way are only Irish ones. Occasionally the scribe complains of his writing materials. Thus, ıꞅ ꝩann membꞃum (the vellum is scanty); ıꞅ ꞇana an ꝺuḃ (the ink is thin); or complains of his health, as, uch mo chlıab a noıb ınꝩen (alas, my chest, O holy Virgin!). But the following memoranda are important as they furnish means to determine the date of the MS.

"1. A gloss at p. 157: *Hucusque Calvus Patricii depinxit,*

showing that the name of one of the scribes employed on the work was Maelpatraic, of which *Calvus Patricii*, the tonsured (servant) of Patrick, is a literal translation. In like manner, Maelsuthain, the spiritual adviser of Brian Boroimhe, signed his name as *Calvus Perennis* in the Book of Armagh. The Irish Annals mention several persons of this name, which was common in the ninth and tenth centuries; and two of them are actually said to have been *scribes*. Maelpatraic, son of Finnchu, bishop, scribe, and anchorite, and abbot elect of Armagh, died A. D. 861. Another Maelpatraic, scribe, wise man, and abbot of Treoit (Trevet in the county of Meath), died A. D. 885. Persons of the same name, abbots of Monasterboice, Clonmacnoise, and Slane, are also mentioned as having died in the years 875, 883, and 886.

"2. At p. 194, marg. inf., we find, do inis Maddoc dún .i. meisse ⁊ Choirbbre, i. e. of Inis Maedhoc are we, i. e. myself and Coirpre. This gloss has caused some perplexity to Professor Zeuss, who was not aware that the island here spoken of was named after the celebrated Irish saint, Maedhoc of Ferns. It is in the lake of Templeport, in the county of Leitrim, and retains its name to the present day. We learn from this gloss the exact district in Ireland from which the writer came. The Coirpre here mentioned may possibly have been Coirpre Crom, Bishop of Clonmacnoise, who died A. D. 889. But the name was so common a one that little weight can be attached to the conjecture.

"3. There is another marginal note unfortunately imperfect, of which just enough remains to show that this transcript of Priscian was made under the superintendence of a person named Maelbriget. This note is as follows :—: : : aithar Patric ⁊ brig. ar Maelbrigtae namba olcc a menma frimm : : : : scribund ro scribad in dul so. The sentence is incomplete, but it plainly amounts to a prayer addressed to St. Patrick and St. Bridget, that Maelbridget may not be dissatisfied with the scribe's performance. Maelbrighde was a very com-

mon name amongst ecclesiastics in the ninth, tenth, and eleventh centuries. M. Bishop of Slane, died A. D. 874. M. Abbot of Clonmacnoise, A. D. 888. M. Comorb of Patrick, A. D. 889. M. son of Tornan, became Bishop of Armagh, A. D. 885, and died at an advanced age, A. D. 926.

"4. At p. 112, the following quatrain is written in the margin:—

> Is acher in gaith innocht,
> Fa fuasna fairrcae findḟolt.
> Ni ágor reime mora minn
> Dond laechraid lainn oa Lochlind.

Of which the following is a translation:

> Bitter is the wind to night,
> To ruffle the white crest of the sea.
> Long and smooth voyages are not accomplished
> By the fierce warriors from Lochlinn.

"The mind of the writer was evidently full of the ravages of the Danes who plundered all the great ecclesiastical establishments of Ireland during the ninth century. The Annals record that Clonmacnoise, and many other ecclesiastical establishments, were plundered and burned by the Danes under Turgesius in the year 843; Armagh experienced a like fate in the years 831, 839, 850, 867, 893.

"5. The gloss Ruaidri adest, p. , probably furnishes us with the means of fixing the actual year in which the MS. was written. For we learn from the Annals of the Four Masters, at the year 874, that Ruaidhri, son of Morminn, King of Britain (i. e. Wales), came to Ireland to shun the Danes. Such an event was very likely to be noticed by a scribe, particularly if it happened that the monarch came to the place where he was.

"According to the Welsh Chronicles, this Ruaidhri, called by the Welsh Rodric Mawr, son of Mervyn the Freckled, was

killed by the Saxons in the year 876. The Annals of Ulster record this event at the year 877.

"From what has been said we may safely conclude that the MS. was written in Ireland towards the close of the ninth century; and the style of the writing as compared with that of the Book of Armagh, written in the beginning of the same century, fully confirms this inference.

"Having now established the date of the Oghams, let us proceed to describe them.

"They are as follows:—

"I. Page 50, marg. inf.—FERIA CAI HODIE.—This marked the 4th of October, which, as we learn from the Martyrology of Marianus Gormanus, was kept in the Irish as well as in other Churches, as the anniversary of the Caius, or Gaius, and Crispus, mentioned 1 Cor. i. 14.

"II. Page 70, marg. sup.—fel martain—i. e. the Festival of St. Martin of Tours, kept on the 11th of November. St. Martin, as the supposed uncle of St. Patrick, was specially honoured in Ireland. Churches were dedicated to him, and the name is preserved in those of parishes and townlands to this day.

"III. Page 170, marg. sup.—minchasc—i. e. *Pascha minor*, or Low Sunday. The word is still in vernacular use. This Ogham has been slightly mutilated in the binding of the MS., but enough remains to make the reading certain.

"IV. V. VI. Pages 193, 194, 195, marg. sup.—cogart—i. e. *Corrige*. The word is not to be found in the dictionaries; but there can be no doubt as to its meaning. We have at p. 90, ol arcogarti as a gloss on the Latin *quod sit emendandum*.

"VII. Page 195, marg. sup.—ascogart inso.—i. e. *Hoc est corrigendum*. Compare the gloss just referred to: also, ni aedparthi inso (gl. *minime hoc est adhibendum*); also a gloss in the Wurtzburgh MS. of St. Paul's Epistles, cid arbénti fri sin tra (gl. quid ergo fratres? i. e. quid faciendum in hoc ergo).

The scribe has used the character called *eamhancoll* to stand for the letters ꞅc in aꞃꞅcoᵹaꞃꞇ. According to the Uraicept it is properly used to denote *x*, which is equivalent to *cs*: but Irish scribes sometimes put *sc* for the Latin *x*, e. g. ascella for axilla; Mascimin for Maximin. The present mode of writing is thus easily explained.

"VIII. Page 204, marg. sup.—Lacheiꞃꞇ.—The same word occurs in the ordinary character at p. 189. I cannot pronounce any positive opinion as to its signification. Professor Zeuss understands it to mean at the third hour, and refers to a gloss ꞇeꞃꞇıa hoꞃa, at the bottom of p. 212. But this explanation leaves the aspiration of the ꞇ unaccounted for. In Cormac's Glossary we find a word laꞇhoıꞃꞇ, so little differing in orthography that it may be equivalent to the one before us.

"Laıꞇhoıꞃꞇ .ı. Laıꞇh oꞃꞇ .ı. laıꞇh ꞅo n-oꞃꞇ .ı. ol coꞃmae.

"Laıꞇhoıꞃꞇ, i. e. from laıꞇh, champion, and oꞃꞇ, it overcomes, i. e. drinking ale.

"It seems unlikely that this is the true interpretation of the Ogham word, though it might possibly be a gloss on some such word as *ebrietas* or *crapula*.

"At the commencement of each of these Ogham notes the following mark occurs: ⩥. It is used in the Books of Leinster, Lecan, and Ballymote; and generally in Irish MSS., where specimens of Ogham writing are introduced. On a large silver brooch in the Museum of the Royal Dublin Society, it is used both to mark the beginning of each line of Ogham writing, and to separate names from one another. In the Ogham, No. VII., a point is used for this purpose between the words coᵹaꞃꞇ and ınꞅo. There is also a point at the end of No. I. In Ogham inscriptions occurring on monuments I have met with indubitable instances of stops employed to separate words. But the difficulty of distinguishing between natural and artificial marks ought to make us careful not to pronounce too positively in cases of this kind.

"It is to be observed that the diphthongs occurring in these

Oghams are written in full, instead of being represented by the forfeadha, which are said to have been invented for the purpose.

"In concluding my notice of these Oghams, I must remark, that they furnish an unanswerable proof that the Ogham character was in use amongst Irish ecclesiastics in the Middle Ages. That Clonmacnoise was a distinguished seat of Ogham lore is proved by the following stanzas, occurring at the beginning of an ancient poem on the families buried in that cemetery :—

Caṫair Ciaran Cluain mic nois,
baile drúċtṡolus deargróis.
Do tríl rígraiġe ar buan blaġ
Sluaiġ fan ríṫḃaile sruiṫġlan.

Atáit uaisle Cloinde Cuind
Fán relig lecaid, leargḋuind.
Snaiḋm nó craeḃ ós gaċ colaind
Acas ainm ċaeṁ ċeart ogaim.

That is,

Clonmacnoise is the city of Ciaran,
A place of bright dews and red roses.
Of the race of kings of lasting fame
There is a host beneath the peaceful sacred place.

The nobles of the Clann Cuinn lie
Beneath the flagged, brown, sloping cemetery.
A knot or branch (craobh) over each body,
And a correct Ogham name.

"My attention was pointed to this poem by Mr. Eu
Curry, who found it in a MS. in the Bodleian Library at
ford, marked Rawlinson, 406, at fol. 7.

"The truth of the statement here made is confirmed b
discovery, at Clonmacnoise, of a tombstone bearing the

Colman in the Irish character, with the word bocht [poor] written under it in Ogham. I doubt whether this tombstone is still to be found. My information respecting it is derived from Dr. Petrie, who furnished me with a drawing of the monument made by him several years ago. Since then many of the monuments have been broken, buried, or removed to other churchyards in the neighbourhood."

Rev. Robert Carmichael, F.T.C.D., read a Paper on Laplace's Equation and the Calculus of Quaternions.

"Early in the year 1852 it accidentally suggested itself that the celebrated Equation of Laplace's Functions, which had hitherto, for all practical purposes, baffled the powers of ordinary analysis, might possibly be solved with simplicity, and in a form admitting of useful application, by the new method of analysis discovered by Sir William Hamilton. The results of the investigation thus set on foot were published in the 'Cambridge and Dublin Mathematical Journal,' February, 1852.

"To one starting with the simpler equation,

$$D_x^2 U + D_y^2 U = 0,$$

the solution of which was known to be

$$U = \Phi (x + iy) + \Psi (x - iy),$$

where $i^2 = -1$, it seemed probable that the solution of the higher equation,

$$D_x^2 V + D_y^2 V + D_z^2 V = 0,$$

should be susceptible of deduction by the employment of two imaginaries i and j, governed by the laws

$$i^2 = -1, \quad j^2 = -1, \quad ij = -ji.$$

The integral thus deduced appeared to be

$$V = \Phi (x + iz,\ y + jz) + \Psi (x - iz,\ y - jz).$$

Unable to interpret this form, and impressed with the conviction that, to render the solution, if true, of any value, such in-

terpretation was absolutely necessary, I took the liberty of soliciting the attention of mathematicians to this point.

"Having been honoured with communications from England and France in connexion with this paper, I resumed the subject in the early part of the year 1853, and entered into correspondence with Sir William Hamilton. With his valuable assistance I hoped to be able to overcome two difficulties which seemed to lie in the way of interpretation. It appeared desirable that the form of solution should be rendered more purely symmetrical by the introduction of the third imaginary unit k, and that by the aid of the same new element the character of the solution might be rendered more purely *spatial.* In one sense this form is undoubtedly spatial. If, however, we extract from it the explicit vector-unit, we get

$$i \cos a + j \sin a,$$

which, as referring to an unit circle is planar, whereas it would be desirable that the explicit vector-unit should be

$$i \cos a + j \cos \beta + k \cos \gamma,$$

referred to the unit sphere.

"In the month of January, 1854, Sir William Hamilton pointed out the necessity of introducing some modification in the form of the solution as stated, arising out of the non-commutative character of the terms $x + iz$, $y + jz$, and $x - iz$, $y - jz$.

"In the early part of the present year this modification was supplied by Professor Graves, but the same objections lie against the modified form:

$$V = M\Phi\,(x + iz,\ y + jz) + M\Psi\,(x - iz,\ y - jz).$$

In the first place this form is not purely symmetrical; and in the second place, its character is not purely spatial. For these reasons it seems, I would say with all due respect, improbable that any interpretation of this form can be devised which will meet the requirements of physical research.

" Now the symbolic form of Laplace's equation which was integrated was

$$(D_z - iD_x - jD_y)\,(D_z + iD_x + jD_y)\,.\,V = 0,$$

which is obviously unsymmetrical. It appears then possible, that in order to have arrived at a solution susceptible of useful application, we should not have taken this form, but one purely symmetrical, and such was pointed out nearly nine years since by Sir William Hamilton, namely,

$$(iD_x + jD_y + kD_z)^2\,.\,V = 0.$$

Now, if we confine our regard to this latter form, and substitute for the imaginary symbols real quantities a, b, c, it can readily be shown that the solution of the equation,

$$(aD_x + bD_y + cD_z)^2\,.\,V = 0$$

is

$$V = \left(\frac{x}{a} + \frac{y}{b} + \frac{z}{c}\right)\,.\,u_0\left(e^{\frac{x}{a}},\ e^{\frac{y}{b}},\ e^{\frac{z}{c}}\right) + v_0\left(e^{\frac{x}{a}},\ e^{\frac{y}{b}},\ e^{\frac{z}{c}}\right),$$

where u_0 and v_0 are arbitrary homogenous functions, of the order zero, of the quantities respectively under them, or

$$V = \left(\frac{x}{a} + \frac{y}{b} + \frac{z}{c}\right)\Phi\left(\frac{y}{b} - \frac{z}{c},\ \frac{z}{c} - \frac{x}{a},\ \frac{x}{a} - \frac{y}{b}\right) + \Psi\left(\frac{y}{b} - \frac{z}{c},\ \frac{z}{c} - \frac{x}{a},\ \frac{x}{a} - \frac{y}{b}\right).$$

If now, in the right-hand member of these equations, we replace the real quantities a, b, c, by the imaginary symbols i, j, k, respectively, we get

$$\left(\frac{x}{i} + \frac{y}{j} + \frac{z}{k}\right)\,.\,u_0\left(e^{\frac{x}{i}},\ e^{\frac{y}{j}},\ e^{\frac{z}{k}}\right) + v_0\left(e^{\frac{x}{i}},\ e^{\frac{y}{j}},\ e^{\frac{z}{k}}\right),$$

and

$$\left(\frac{x}{i} + \frac{y}{j} + \frac{z}{k}\right)\Phi\left(\frac{y}{j} - \frac{z}{k},\ \frac{z}{k} - \frac{x}{i},\ \frac{x}{i} - \frac{y}{j}\right) + \Psi\left(\frac{y}{j} - \frac{z}{k},\ \frac{z}{k} - \frac{x}{i},\ \frac{x}{i} - \frac{y}{j}\right),$$

and modifications of these analogous to that established so conclusively by Professor Graves, for the previous form, will give, I think, solutions of Laplace's equation, which will satisfy the conditions required.

"From the peculiar nature of the symbols it is evident that the expressions last stated may be written in the forms,

$$\rho \cdot u_0(e^{-\xi}, e^{-\eta}, e^{-\zeta}) + v_0(e^{\xi}, e^{\eta}, e^{\zeta})$$

and

$$\rho \cdot \Phi(\eta - \zeta, \zeta - \xi, \xi - \eta) + \Psi(\eta - \zeta, \zeta - \xi, \xi - \eta),$$

where ξ, η, ζ, are the co-ordinates of the point x, y, z, in magnitude *and direction*, or, if I may presume to invent the phrase, *the components* of the points x, y, z, and ρ the vector of this same point.

"There is a peculiarity about this expression to which it may be well to solicit attention. It is known to all physicists that, in the lunar theory, and in that of the perturbed motion of pendulums, there occur equations of the form,

$$u = \frac{\theta}{2n} \cdot \sin(n\theta + a) + A\cos(n\theta + B) + \&c.,$$

implying that the value of u is not simply periodic, but admits of indefinite increase.

"Similarly, in the above expression, we observe in the first term the vector ρ outside the arbitrary function, a circumstance likely to add considerably to the interest of the physical interpretation of the solution.

"That the modified form of this expression will satisfy the requirements of physical research, appears probable from the considerations, that it must be perfectly symmetrical, that it must be spatial, and that even the notation exhibits a semi-physical character.

"The exact nature of the requisite modification I am not at present prepared to state to the Academy, but with the existence of such I am strongly impressed, and as the subject has recently attracted much attention, these remarks have been submitted in the hope of contributing to the production of a result which possesses much interest both for the mathematician and the physicist.

"It may be well to add, that the two other forms in which

the solution of Laplace's equation were presented in the paper of February, 1852,—namely,

$$V = \begin{Bmatrix} \Sigma A e^{m_1 x + m_2 y} \{\cos \sqrt{(m_1^2 + m_2^2)}\, z + i_P \,.\, \sin \sqrt{(m_1^2 + m_2^2)}\, z\} \\ + \\ \Sigma B e^{m_1 x + m_2 y} \{\cos \sqrt{(m_1^2 + m_2^2)}\, z - i_P \,.\, \sin \sqrt{(m_1^2 + m_2^2)}\, z\} \end{Bmatrix},$$

with its duplicate

$$V = \begin{Bmatrix} \Sigma A e^{\sqrt{(m_1^2 + m_2^2)} z} \{\cos (m_1 x + m_2 y) + i_P \,.\, \sin (m_1 x + m_2 y)\} \\ + \\ \Sigma B e^{\sqrt{(m_1^2 + m_2^2)} z} \{\cos (m_1 x + m_2 y) - i_P \,.\, \sin (m_1 x + m_2 y)\} \end{Bmatrix}.$$

where

$$i_P\, i = \cos a + j \sin a\,;$$

and

$$V = \begin{Bmatrix} \iint \Phi\, (m_1, m_2)\, e^{m_1 x + m_2 y} \,.\, \cos \sqrt{(m_1^2 + m_2^2)}\, z \,.\, dm_1 dm_2 \\ + \\ \iint \Psi\, (m_1, m_2)\, e^{m_1 x + m_2 y} \,.\, \sin \sqrt{(m_1^2 + m_2^2)}\, z \,.\, dm_1 dm_2 \end{Bmatrix},$$

with its duplicate

$$V = \begin{Bmatrix} \iint \Phi\, (m_1, m_2) \cos (m_1 x + m_2 y)\, e^{\sqrt{(m_1^2 + m_2^2)} z} \,.\, dm_1 dm_2 \\ + \\ \iint \Psi\, (m_1, m_2) \sin (m_1 x + m_2 y)\, e^{\sqrt{(m_1^2 + m_2^2)} z} \,.\, dm_1 dm_2 \end{Bmatrix},$$

the limits of the integrals in both cases being supposed independent of the quantities x, y, and z,—stand unaffected."

Professor Graves observed, with reference to Mr. Carmichael's paper, that he entertained great hopes that Mr. Carmichael would succeed in discovering the requisite modification of the symmetrical expression now exhibited by him to the Academy, so as to make it actually satisfy Laplace's equation. Professor Graves stated that he had pursued the same track of investigation himself; but he had abandoned it in consequence of his finding that the expression

$$\Psi \left(\frac{y}{j} - \frac{z}{k},\ \frac{z}{k} - \frac{x}{i},\ \frac{x}{i} - \frac{y}{j} \right),$$

in which Ψ denotes an arbitrary function, is not a true solution of Laplace's equation. This becomes at once apparent on trying the case in which the function just given reduces to

$$\left(\frac{y}{j} - \frac{z}{k} \right)^2, \text{ or } - (y^2 + z^2).$$

Professor Graves, D.D., read a Paper on the solution of the equation of Laplace's functions.

" It is not my design, in the present communication, to discuss the results obtained by giving particular forms to the arbitrary functions f_1 and f_2, which enter into the expression,

$$V = Mf_1(y + jx,\ z + kx) + Mf_2(y - jx,\ z - kx),$$

which I lately presented to the Academy as the complete solution of the equation

$$\frac{d^2V}{dx^2} + \frac{d^2V}{dy^2} + \frac{d^2V}{dz^2} = 0.$$

" But I propose to give some development to the general formula, in order more plainly to exhibit its nature and the mutual relation of its parts. For this purpose let us take $Mf(y + jx,\ z + kx)$, and after developing it by Taylor's Theorem, let us substitute mean products of j s, and k s for the ordinary products, according to the formulæ of p. 170. It will then assume the form

$$F_1 + jF_2 + kF_3,$$

where

$$F_1 = f - \frac{x^2}{2!}\left(\frac{d^2f}{dy^2} + \frac{d^2f}{dz^2}\right) + \frac{x^4}{4!}\left(\frac{d^4f}{dy^4} + 2\frac{d^4f}{dy^2dz^2} + \frac{d^4f}{dz^4}\right) - \&c.,$$

$$F_2 = x\frac{df}{dy} - \frac{x^3}{3!}\left(\frac{d^3f}{dy^3} + \frac{d^3f}{dydz^2}\right) + \frac{x^5}{5!}\left(\frac{d^5f}{dy^5} + 2\frac{d^5f}{dy^3dz^2} + \frac{d^5f}{dydz^4}\right) - \&c.$$

$$F_3 = x\frac{df}{dz} - \frac{x^3}{3!}\left(\frac{d^3f}{dy^2dz} + \frac{d^3f}{dz^3}\right) + \frac{x^5}{5!}\left(\frac{d^5f}{dy^4dz} + 2\frac{d^5f}{dy^2dz^3} + \frac{d^5f}{dz^5}\right) - \&c.;$$

f being used for brevity to denote $f(y, z)$. It is very easy to ascertain the law according to which the coefficients of the different powers of x are formed. In F_1 the coefficient of x^{2n} is,

$$\frac{(-1)^n}{(2n)!}\left\{\frac{d^2}{dy^2} + \frac{d^2}{dz^2}\right\}^n f.$$

In F_2 the coefficient of x^{2n+1} is,

$$\frac{(-1)^n}{(2n+1)!}\frac{d}{dy}\left\{\frac{d^2}{dy^2} + \frac{d^2}{dz^2}\right\}^n f;$$

nd in F_3 the coefficient of x^{2n+1} is

$$\frac{(-1)^n}{(2n+1)!}\frac{d}{dz}\left\{\frac{d^2}{dy^2}+\frac{d^3}{dz^2}\right\}^n f.$$

"With respect to these expressions F_1, F_2, F_3, the following circumstances deserve notice:—

"1. They are entirely freed from imaginaries.

"2. Any one of them is a solution of Laplace's equation.

"3. They are connected together by the relations

$$\frac{dF_2}{dz}=\frac{dF_3}{dy},\quad \frac{dF_3}{dx}=\frac{dF_1}{dz},\quad \frac{dF_1}{dy}=\frac{dF_2}{dx},$$

in virtue of which, the expression

$$F_1dx+F_2dy+F_3dz$$

is an exact differential.

"4. From the fact that F_1 is a solution of Laplace's equation, it follows, that F_2 and F_3 are likewise solutions. For as

$$F_2=\int_0^x D_2F_1.$$

$$(D_1^2+D_2^2+D_3^2)\,F_2=\int_0^x D_2(D_1^2+D_2^2+D_3^2)\,F_1=0,$$

and a similar proof applies in the case of F_3.

"5. Writing f_2 in place of $\frac{df}{dy}$ in F_2, or $\frac{df}{dz}$ in F_3, we see that

$$F_2=xf_2-\frac{x^3}{3!}\left(\frac{d^2f_2}{dy^2}+\frac{d^2f_2}{dz_2}\right)+\frac{x^5}{5!}\left(\frac{d^4f_2}{dy_4}+2\,\frac{d^4f_2}{dy^2dz^2}+\frac{d^4f_2}{dz^4}\right),\ \&c.,$$

will be a solution of Laplace's Equation, whatever function of y and z is denoted by f_2.

"6. If we add this value of F_2 to F_1, we obtain a solution involving two arbitrary functions. It is exactly in this form that Lagrange has presented the solution of Laplace's Equation in his "Mecanique Analytique," p. 520.

"7. It appears, then, that we are able to *deduce* a complete solution of Laplace's Equation from *one* of the arbitrary func-

tions Mf_1, Mf_2: and this arises from the mixture of real and imaginary quantities in them.

"8. The solution just mentioned, viz., $F_1 + F_2$, might be written in the form

$$\{1 + D_1^{-2}(D_2^2 + D_3^2)\}^{-1}(f_1 + xf_2).$$

This transformation suggests an elementary process, by means of which the solution of Laplace's function, in the form of a series arranged according to ascending powers of x, may be obtained without recourse to imaginaries. Let the equation,

$$(D_1^2 + D_2^2 + D_3^2)\, V = 0,$$

be integrated twice with respect to x; ϕ_2 and ϕ_1, two arbitrary functions of y and z, being successively introduced in the integration; it will then assume the form

$$\{1 + D_1^{-2}(D_2^2 + D_3^2)\}\, V = x\phi_2 + \phi_1.$$

Hence we shall have,

$$V = \{1 + D_1^{-2}(D_2^2 + D_3^2)\}^{-1}(x\phi_2 + \phi_1).$$

The development of the operations here indicated will actually produce a result equivalent to Lagrange's. So long ago as in February, 1848, I had suggested this mode of treating differential equations; but I had then little notion of the possibility of applying it with any success in the case of an equation so intractable as that of Laplace's coefficients."

Dr. Todd presented a rubbing made by him from an inscribed tombstone in the north transept of the church of Galway. It bears the following inscription:—

HIR · LIETH · THE · BODI · OF · ON · MORIÆRTAH · OTIERNAGH · AND · HIS · WIF · KATERINA · NIGONOHW · AND · HIS · BROTHER · TEIGE · OG · CVPERS · AN° · DNI · 1580 ·

The stone is elaborately ornamented, and bears on it also a representation of an adze and square, or rule, the emblems of the trade of coopers, to which the brothers O'Tiernagh belonged.

Dr. Todd drew attention to the form of the wife's name, "Katerina ni-Gonow," the *ni* being the correct form of the Irish patronymic for a female, corresponding to the *O'* for a male.

Under the word OTIERNAGH in the inscription are the words "ꝛ. TEIG" in a smaller character, but of the same date, i. e. "and" or "et Teig," alluding to the younger brother Teig og, who was interred in the same tomb.

Dr. Ball read extracts from a letter from Professor Harvey, dated Melbourne, 10th January last, in which he stated that he had just packed up his Victoria collection of Algæ, and had examined and named all the new species; and that, including the West Australian collection, his list shows 556 species. He enclosed for the "Annals of Natural History" a description of some of his new genera: as Bellotia, named in honour of Lieut. Bellot, who perished in search of Sir John Franklin; Apjohnia, called in remembrance of Dr. and Mrs. Apjohn; &c., &c. A specimen of the Apjohnia was exhibited. Dr. Harvey was about to sail for Van Dieman's Land, and expected to proceed to Sydney in May.

Dr. John Barker exhibited some bracteate coins, said to have been found in a place called the Giant's Grave, within six miles of Belfast.

Monday, April 23rd, 1855.

LIEUT.-COL. LARCOM, F. R. S., Vice-President, in the Chair.

Rev. Dr. Todd presented a rubbing of the ancient inscription on the base of the cross which stands in the principal street of the village of Cong. This inscription does not appear to have been ever published, nor do the names it contains occur in the Irish Annals. It is written in the black letter text of the fourteenth century, and not in Irish characters, although it is in the Irish language. It is very much effaced, and by no means easy to read, but Dr. Todd, with the assistance of Dr. Petrie, who had copied it many years ago, has succeeded in deciphering it as follows :—

Or' do nichol ag' do gille bert o dubthaich ra bin abaiddeact Cunga.

Which he reads thus:

oroit do nichol agus do gillebert o dubthaich ra bin abaidheact cunga.

"A prayer for Nichol and for Gillebert O'Dubhthaigh [O'Duffy], who were Abbots of Cong."

Dr. Wilde gave it as his opinion, that the base or steps on which the cross stands were of an earlier date than the present shaft of the cross; and he mentioned a report current in the town, that many years ago the ancient cross was carried away by some soldiers and thrown over the bridge into the river. It is said by some that it was recovered and replaced, but others think that this was not so, and that the present shaft belongs to a cross that formerly stood in the old abbey burial-ground.

Dr. Todd presented an accurate drawing of a chalice made some time ago by Mr. M'Carthy; and stated that when

such antiquities could not be themselves procured and preserved in the Museum, it was very important to have correct drawings of them made to scale, as this was. The chalice was of silver, and stood 5¾ inches high; the bowl was 3⅛ inches in diameter, and the foot, which was octagonal, with eight segments of circles, as the bases of each of the triangles of the octagon, was 5 inches from point to point, and 4 inches from hollow to hollow.

Round the foot ran the following inscription:—

ihs. Conosus Maguir rex fermanach me fi. fe. m°. cccc°. xix°.

Dr. Todd showed that this was the Cuchonacht Maguire, chief of Fermanagh, who was murdered by his own relatives in 1537. At that year the Four Masters record his death, and give him a high character for virtue, piety, and devotion to the Church,—so that it was quite in accordance with his character to find his name on a sacramental chalice. He was buried at first in an island in Loch Erne, where there was a small monastic establishment, but his remains were afterwards removed to the Abbey of Donegal by the Franciscan friars of that monastery, and interred there with great solemnity.

The following Address to His Excellency the Lord Lieutenant was adopted by the Academy:—

"*To His Excellency George William Frederick Earl of Carlisle, Lord Lieutenant General and General Governor of Ireland, &c.*

"MAY IT PLEASE YOUR EXCELLENCY,

"We, the President, Council, and Members of the Royal Irish Academy, beg to tender to your Excellency our respectful congratulations on your return to this country in the high office of Her Majesty's Representative.

"In approaching your Excellency as the Visitor of the Academy, appointed by our Charter, it is with pleasure we re-

cognise in you, not only the Representative of our gracious Sovereign, but also the man of letters, whose cultivated mind and varied and eminent attainments point him out as individually qualified for such a position, independently of any civil or official rank.

"Your Excellency is already well acquainted with the literary and scientific institutions of Ireland, and you are therefore aware that the Academy was founded by the Charter of His Majesty King George III. for promoting the study of the Abstract and Physical Sciences, Polite Literature, and Antiquities.

"It may be necessary to say, that since the period of your Excellency's former residence in Dublin, we have obtained, from the liberality of Government, a large and convenient residence, much better adapted to our purposes than that which was formerly occupied by the Academy, and provided with ample accommodation for our Library, as well as for our Museum, which can now be displayed and arranged as its importance and national character deserves.

"The Museum, which is confined to Irish Antiquities, has of late years received great and valuable additions, chiefly from the liberal contributions of the zealous friends of Irish history and antiquities, amongst whom it is gratifying to us to be able to reckon your Excellency, and to thank you for a contribution to this department of our labours, transmitted to us immediately on your arrival here, and before you had publicly entered upon your Viceregal duties.

"It is not for us to speak of the merit of the literary efforts of our members, which have been published in our Transactions and Proceedings: we would only remark, that we have endeavoured to cultivate the branches of learning to which our Academy is devoted, in such a manner as to hold out to every one, with strict impartiality, that meed of praise and of honour which his exertions and attainments have earned.

"Ireland is now, we trust, recovering from the late cala-

mitous difficulties which depressed her trade and impoverished her people; and we earnestly hope that your Excellency's administration, in giving force to the impetus which she has already received, will be crowned with that successful promotion of all useful arts, whether literary or practical, which we know it will be your Excellency's most anxious wish to cultivate, and with which we believe the true peace, prosperity, and happiness of Ireland will always be identified."

Monday, May 14th, 1855.

GEORGE PETRIE, LL. D., Vice-President, in the Chair.

Edmund William Davy, Esq., M. B., was elected a Member of the Academy.

The Secretary of the Academy read the following Answer of His Excellency the Lord Lieutenant to the Address adopted by the Academy at the last meeting :—

"Gentlemen,

"I request the President, Council, and Members of the Royal Irish Academy, to accept my sincere thanks for the obliging expressions which they have addressed to me personally, as well as officially, upon my arrival in Ireland.

"I rejoice to find, that since the period of my former acquaintance with your proceedings, you have obtained a more commodious area for their future development; I doubt not that your zeal and spirit will keep pace with your enlarged local proportions :—

'Dignis invitant Pallada templis.'

"I believe it to be your laudable ambition so to collect, preserve, and investigate what has been bequeathed by the past, as to make it illustrate the present, and improve the future; this is the beneficent method of making remote generations react upon each other, and rendering your contemporaries heirs to the treasures of former knowledge and wisdom, and ministers to the continual progress of Literature, Science, and Art.

"I earnestly trust that such a course will be long reserved, amidst the increasing repose and prosperity of your country, for the Royal Irish Academy."

The Rev. Professor Haughton communicated the following Paper on the granites of the province of Leinster.

"The granites of the south-east of Ireland occur in the counties of Dublin, Carlow, Kilkenny, Wicklow, and Wexford, and may be divided physically into two distinct groups.

"1st. The chain of granite hills extending from Booterstown and Dalkey, county of Dublin, in a N.N.E., S.S.W. direction, to Poulmounty, in the south of the county of Carlow, within five miles of New Ross. This granite chain has a length of sixty-eight miles, and a breadth varying from eight to fifteen miles.

"2nd. The series of granite hills, occurring at intervals in the slate of the counties of Wicklow and Wexford, isolated from each other, and rising like islands through the slate. This group of granite hills lies between the main chain and the sea, and appears to be arranged in lines parallel more or less to the axis of the main chain.

"These granite hills are about twenty in number, and extend for a distance of forty-three miles from Ballinaclash, county of Wicklow, to Camaross Hill, county of Wexford.

"Hitherto, so far as I am aware, no decisive proof of difference of geological age has been discovered between these two groups of granites. They are both newer than the Silurian slates, which they penetrate and metamorphose. The following statement, which I have received from Dr. Griffith, to whom I communicated my results, contains the substance of what is known as to the relative geological age of these granites.

"'*Athenæum Club, London,*
"'*12th May*, 1855.

"'DEAR SIR,—In reply to your query relative to the granites of the counties of Wicklow and Wexford, I would observe that in my view the district presents two distinct regions of igneous action, the products of different and probably distant periods.

" 'The first and oldest consists of the well-known granite range which extends in a south-western direction from Dublin Bay, through the counties of Dublin, Wicklow, and Wexford, to Brandon Hill in the county of Kilkenny.

" 'The second presents a more mixed and complicated character, and appears at the surface in the form of numerous elongated detached hills, which also affect a north-eastern and south-western direction, but do not for any great length preserve one direct line; and as in some cases they present at the surface numerous mineralogically distinct rocks, as granite, greenstone, greenstone porphyry, compact feldspar, and endless passages of some of these into each other, consequent on variations in the proportions of their mineral constituents,—it is possible and probable they all belong to the same period of igneous action, which extended over a considerable space, both longitudinally and laterally, in the counties of Wicklow, Wexford, and also Waterford. But, confining my observations for the present to the hills of granite, I may state that detached hills and level tracts composed of that rock occur in three distinct lines to the eastward of the principal granite range.

" 'Starting from the north, the most western commences about three miles north-east of Rathdrum, in the county of Wicklow, and extends in a south-western direction, forming detached ridges of hills, and passing the village of Ballinaclash, terminates to the north of the village of Aughrim. Preserving the same general direction, we next observe granite occurring in Croghan Kinshela Mountain, and extending south-westward to Conna Hill, in the county of Wexford, which may be considered the termination of the most western secondary granite district.

" 'In an eastern direction from the foregoing, detached granite hills occur to the south of the village of Oulart, in the county of Wexford; and in continuation of the same line through about eight miles (Irish) to the south-west, we have the remarkable granite hill of Camaross, situate nearly midway between the towns of Wexford and New Ross. Again, we find granite occupying a considerable tract to the northward and westward of Carnsore Point, on the coast of the barony of Forth, nearly twenty miles to the eastward of the line of Oulart and Camaross.

" ' In regard to the constituents of the rock which occurs in the several lines and positions above mentioned, it may be stated that the granite of the western, or principal range, consists of white feldspar, gray quartz, and white, or greenish, or yellowish-white mica, which latter sometimes passes into talcose mica, the prevailing accidental minerals being schorl and common garnet.

" ' The granite of the first or most western detached range, that commences north-east of Rathdrum, and terminates at Conna Hill, consists for the most part of constituents similar to those of the great or principal range, viz., white feldspar and white mica, though red feldspar and black mica do occur north of West Acton in Wicklow county. But the constituents of the granite hills, south-west of Oulart, and also of Camaross Hill and that of the Carnsore district, all in Wexford, differ from the former, and consist of red feldspar, gray quartz, black mica, and hornblende. Some time since it occurred to me that possibly these newer granites might be distinguished from the older by the occurrence of potash in the one, and soda in the other; but this is merely surmise, not being aware of any analysis having been made.

" ' I am, my dear Sir, faithfully yours,

" ' RICHARD GRIFFITH.

" ' *Rev. Professor Haughton,*
" ' *Trinity College, Dublin.*'

" Such being the state of geological knowledge on this subject, it occurred to me that it might be useful to direct attention to a distinction of a chemical character which appears to exist between these two groups of granites—a distinction to which I have been led in the course of a series of analyses of Irish granites, in which I have been for some time engaged. The distinction to which I have alluded is the following. The granites of the main chain contain more potash than soda, and *vice versâ*, the granites to the east of the chain, which are isolated from it and from each other, contain more soda than potash,—showing that the circumstances, unknown to us, under which the isolated granites were formed, were such as to

yield to the molten mass a quantity of soda greater than that possessed by the granites of the principal chain.

"In illustration of the foregoing generalization, I offer analyses of granites from the following localities:—

GRANITIC CHAIN.

1. Dalkey, county of Dublin.
2. Fox-Rock, county of Dublin.
3. Three-Rock Mountain, county of Dublin.
4. Enniskerry, county of Wicklow.
5. Ballyknocken, county of Wicklow.
6. Kilballyhugh, county of Carlow.
7. Blackstairs, county of Wexford.
8. Ballyleigh, county of Wexford.

ISOLATED GRANITES.

1. Cushbawn, county of Wicklow.
2. Croghan Kinshela, county of Wicklow.
3. Ballymotymore, county of Wexford.
4. Ballynamuddagh, county of Wexford.

"It will be seen, on reference to the Ordnance Map, or any good map of Ireland, that the localities selected extend from the north to the south of both the granite series; and on reference to the Geological Maps of Wicklow and Wexford, it may be observed by those unacquainted with the geological structure of this part of Ireland, that the granites of the second group examined are taken from four distinct and distant isolated patches of granite.

"In order to investigate the relative proportions of quartz, feldspar, and mica, of which these granites were composed, I used the following method, which appears to be as simple as any that has been proposed for such a purpose.

"Let the per-centage of silica in the granite be divided by the atomic weight of silica, and let the quotient be denoted by a.

"Let the per-centages of alumina and peroxide of iron be divided by the atomic weights of alumina and peroxide of iron respectively, and let the sum of the quotients so found be denoted by b.

"Let the per-centages of lime, magnesia, potash, and soda, be divided by the atomic weights of these elements, and the sum of the quotients called c.

"Then, on the hypothesis that the granite is composed exclusively of quartz, feldspar, and mica (margarodite), since

$$\begin{aligned} \text{Quartz} &= Si\,O_3, \\ \text{Feldspar} &= RO,\ Si\,O_3 + R_2\,O_3,\ 3\,Si\,O_3, \\ \text{Margarodite} &= RO,\ Si\,O_3 + 2\,(R_2\,O_3,\ Si\,O_3) + 2HO; \end{aligned}$$

we find, if Q, F, M denote the number of atoms of quartz, feldspar, and margarodite present in the granite, the following relations,

$$\begin{aligned} a &= Q + 4F + 3M, \\ b &= F + 2M, \\ c &= F + M. \end{aligned} \qquad (1)$$

In these equations, a, b, c are given by the analysis, and from them Q, F, M may be found.

"Having determined Q, F, M, we can obtain the per-centages corresponding to them, by multiplying Q, F, M by their respective atomic weights. The atomic weight of quartz is known, and is 46; but the atomic weights of feldspar and mica vary with the relative proportions of the ingredients composing these minerals. Assuming the average of the analyses of micas from this granite range, already given by me (Proceedings of Royal Irish Academy, vol. VI. part ii.), it is easy to infer from it an atomic weight of mica equal to 305. This atomic weight of mica has been used by me in the calculations made in this Paper, and the per-centages of feldspar found by difference.

"The calculations just mentioned do not prove that the ... which they are applied are composed of quartz

feldspar, and mica; as combinations of other minerals might equally well represent the analyses; but on the hypothesis that the granites are composed of these three minerals, they give their per-centages with a close degree of approximation; and further, if the equations cannot be satisfied with positive values of Q, F, M, it may be considered as proved that the granite under consideration cannot be simply a compound of quartz, feldspar, and margarodite.

"It is to be observed, that if a granite be composed of four or more minerals, it is not possible to find by the process just described the per-centages of each mineral, because, in this case, the number of unknown quantities is greater than that of the equations from which they are to be calculated.

"The following Table contains the analyses of eight granites taken from north to south along the principal granite chain, and the notes appended contain a few interesting particulars respecting each granite:—

TABLE I.—*Analyses of Granites from Principal Chain.*

LOCALITIES.	Silica.	Alumina.	Peroxide of Iron.	Lime.	Magnesia.	Potash.	Soda.	Loss by Ignition.	TOTALS.
1. Dalkey, ...	70·88	12·64	3·16	2·84	0·53	5·90	3·13	1·16	99·74
2. Fox-Rock, . .	73·00	13·64	2·44	1·84	0·11	4·21	3·53	1·20	99·97
3. Three-Rock, . .	70·28	16·44	2·60	2·04	Trace	5·79	2·82	—	99·97
4. Enniskerry, . .	74·24	13 64	1·40	1·48	Trace	3·95	2·72	1·20	98·63
5. Ballyknocken, .	70·82	14·08	3 47	2·65	0·91	4·64	2·31	1·89	99·67
6. Kilballyhugh, .	73·24	15·45	1·60	0·99	Trace	4·59	3·08	1·20	100·15
7. Blackstairs, . .	73·20	15·18	1·72	0 96	Trace	4·80	3·18	—	99·34
8. Ballyleigh, . .	73·28	12·64	2·00	1·72	Trace	4·70	2·97	1·04	98·35

"No. 1. *Dalkey.*—Specific gravity, 2·647; a fine-grained granite, containing black and transparent mica. This granite cannot be a ternary compound of quartz, feldspar, and margarodite. This granite was used in the construction of Kingstown Harbour.

"No. 2. *Fox-Rock.*—Specific gravity, 2·638; a coarse granite, which strikes fire under the hammer; it forms a durable and strong building stone, and has been employed in the ring-stones of Trinity College Belfry, and in the construction of the O'Connell Monument at Glasnevin.

"No. 3. *Three-Rock.*—Specific gravity, 2·652; this granite is rather coarse-grained; it was taken from Woodside Quarry, on the slope of the Three-Rock Mountain, and, like No. 2, has been used in the construction of the O'Connell Monument.

"No. 4. *Enniskerry.*—Specific gravity, 2·633; a rather coarse-grained granite, containing veins of black tourmaline.

"No. 5. *Ballyknocken.*—Specific gravity, 2·636; this granite is the best building stone in the neighbourhood of Dublin, and has been extensively used in the public buildings of this city; it forms the principal part of the granite used in the Belfry and Museums of Trinity College. The quarries are situated beyond Blessington, in the county of Wicklow.

"No. 6. *Kilballyhugh.*—Specific gravity, 2·616; this is a fine-grained granite, and works freely; it has been employed in the construction of the chapel of ease in the town of Carlow.

"No. 7. *Blackstairs.*—Specific gravity, 2·622; a medium-grained granite from Kiltealy, on the Wexford slope of Blackstairs.

"No. 8. *Ballyleigh.*—Specific gravity, 2·627; a fine-grained granite, taken from near Poulmounty Bridge, at the south-west extremity of the granite chain.

"Calculating the atomic quotients from Table I., we construct the following Table, containing the values of a, b, c, and of Q, F, M, calculated from equations (1).

TABLE II.—*Atoms of Granitic Minerals.*

LOCALITIES.	Atoms of Silex $= a$.	Atoms of Peroxides $= b$.	Atoms of Protoxides $= c$.	Atoms of Quartz.	Atoms of Feldspar.	Atoms of Mica.
Dalkey, ...	1·530	0·286	0·353	—	—	—
Fox-Rock, ...	1·587	0·296	0·274	0·513	0·252	0·022
Three-Rock, ...	1·528	0·352	0·287	0·445	0·222	0·065
Enniskerry, ...	1·613	0·282	0·225	0·770	0·168	0·057
Ballyknocken, . . .	1·540	0·317	0·283	0·442	0·249	0·034
Kilballyhugh, . . .	1·592	0·321	0·232	0·753	0·143	0·089
Blackstairs, ...	1·587	0·322	0·239	0·714	0·156	0·083
Ballyleigh, ...	1·593	0·271	0·257	0·597	0·243	0·014

"Calculating, by the method already described, the per-centages of quartz, felspar, and mica, contained in the different granites, we find the following:—

TABLE III.—*Per-Centages.*

LOCALITY.	Quartz.	Feldspar.	Mica.
Dalkey, ...	—	—	—
Fox-Rock, . . .	23·60	69·66	6·71
Three-Rock, . .	20·47	59·68	19·82
Enniskerry, . . .	35·42	45·83	17·38
Ballyknocken, . .	20:33	68·97	10·37
Kilballyhugh, . .	34·64	38·37	27·14
Blackstairs, . .	32·84	41·19	25·31
Ballyleigh, . . .	26·63	67·45	4·27

"From the foregoing calculations it follows, that, with the exception of the Dalkey granite, the granites of the main chain examined might be represented by combinations of quartz, feldspar, and mica, in which the quartz is the most regular mineral, considered with reference to its per-centage.

"The following Table contains analyses of granite belonging to the second group, and supposed to be newer than the others:—

TABLE IV.—*Isolated Granites.*

LOCALITY.	Silica.	Alumina.	Peroxide of Iron.	Lime.	Magnesia.	Potash.	Soda.	Loss by Ignition.	TOTAL.
1. Cushbawn, . . .	70·32	11·24	4·80	3·01	0·73	2·27	3·39	1·62	97·36
2. Croghan Kinshela	80·24	13·24	0·72	0·89	Trace	0·40	5·58	—	101·07
3. Ballymoty, . . .	66·60	13·26	7·32	3·36	1·22	2·31	3·60	2·34	100·01
4. Ballynamuddagh,	68·56	14·44	5·04	3·85	0·43	2·78	3·36	1·00	99·46

"No. 1. *Cushbawn.*—Specific gravity, 2·671; a fine-grained granite, containing hornblende in addition to mica. Besides the constituents given in the Table, the specimen examined by me contained 1·34 per cent. of carbonate of lime.

"No. 2. *Croghan Kinshela.*—Specific gravity, 2·629; this granite is composed of quartz, feldspar, and chlorite. The specimen examined appeared to be composed exclusively of quartz and feldspar. From the great quantity of soda, I infer that the feldspar of Croghan Kinshela is probably albite. On the northern slope of this mountain are situated the old gold streams of Wicklow.

"No. 3. *Ballymotymore.*—Specific gravity, 2·659; a very fine-grained granite, but containing distinctly feldspar, quartz, and black mica.

"No. 4. *Ballynamuddagh.*—Specific gravity, 2·670; a coarse-grained granite, with large plates of black mica.

"Applying to the preceding granites the method of calculation already employed, we find, excluding the granite from Croghan Kinshela, which contains chlorite in place of mica—

TABLE V.—*Atoms of Granitic Minerals.*

LOCALITY.	Atoms of Silex $= a$.	Atoms of Peroxide $= b$.	Atoms of Protoxide $= c$.	Atoms of Quartz.	Atoms of Feldspar.	Atoms of Mica.
Cushbawn, . . .	1·529	0·278	0·300	—	—	—
Ballymoty, . . .	1·448	0·349	0·346	0·067	0·343	0·003
Ballynamuddagh,	1·490	0·344	0·325	0·209	0·306	0·019

"From the foregoing Table it appears, that the granite of Cushbawn cannot be considered as a ternary compound of quartz, feldspar, and margarodite, and in fact it contains a sensible quantity of a mineral which is either hornblende or chlorite. Calculating the per-centages of quartz, feldspar, and mica of the two granites, which may be represented as composed of these minerals, we find—

TABLE VI.—*Per-Centages.*

Locality.	Quartz.	Feldspar.	Mica.
Ballymoty, . . .	3·08	96·02	0·91
Ballynamuddagh,	9·62	84·05	5·79

"Whatever doubt may be attached to the preceding calculations, owing to the hypothesis on which they are of necessity founded, no such doubt or uncertainty can belong to the results of direct experiment, contained in Tables I. and IV., which have a positive value, independent altogether of the inferences which may be deduced from them. From these Tables I deduce the following as the average composition of the granites of the main chain and of the isolated granites:—

TABLE VII.—*Average Composition of Granites.*

	Main Chain.	Isolated.
Silica, ...	72·805	71·480
Alumina, ...	14 251	13·045
Peroxide of Iron, .	2 299	4·470
Lime, ...	1 815	2·778
Magnesia, ...	0·119	0·595
Potash, ...	4·822	1·940
Soda, ...	2·967	3·982
Loss by Ignition, .	0·899	1·240
Total, ...	99·477	99·480

"On examining Tables I. and IV., several interesting differences present themselves in the composition of the two

groups of granites, in addition to the most important difference, to which I have drawn attention, with respect to their alkaline constituents; but I content myself at present with establishing this fundamental distinction between the two groups, and thus furnishing an additional proof of the service which may be rendered to geological science by the more exact and experimental sciences."

Mr. Robert T. Forster, by permission of the Council, read a paper on the molecular formation of crystals: he first gave an account of preceding theories on this subject, and having shown in what respect these different theories failed, he proceeded to explain by what means we can account for the occurrence of secondary forms in general, and also advanced an hypothesis by which the formation of most hemihedral forms can be satisfactorily demonstrated, and the circumstances under which the various changes take place can be clearly pointed out.

"The first writer whom we find deserving of notice is Huygens, who considered the crystals of Iceland spar to be built up of spheroids. He did not, however, give any explanation why these spheroids are so aggregated.

"Hooke, in his 'Micrographia,' advanced a similar hypothesis, except that he considered the atoms to be spherical, a supposition which is utterly inapplicable to the third or rhombohedral system to which he applied it.

"The next writer who commanded attention was M. Prechtl; he considered a fluid to be made up of soft molecules, which, while the body was undergoing its change of state, suffered a change of form, arising from their mutual pressure, and that under different degrees of compressibility different forms were produced. Not only was this hypothesis quite insufficient, but it was also erroneous in a mathematical point of view, as Dr. Wollaston has fully shown.

"Immediately after him Dr. Wollaston published, in 'The

Philosophical Transactions,' a theory of the formation of the ordinary tetrahedron and octahedron, by means of spheres having a simple mutual attraction for each other; their arrangement may be best described as that of cannon balls piled into an equilateral triangular pyramid.

" I shall now endeavour to show that this theory is faulty, inasmuch as the molecules, if under the influence of mutual attraction, would never assume such an arrangement; for if any four molecules become attached they will form a triangular pyramid, and if a fifth become attached it will touch three others; but in his arrangement the fifth molecule touches only two others, and is in the same plane with three of them, a position which is certainly not that of equilibrium.

" Haüy considered the ultimate atom to have the same form as the solid obtained by cleavage, he did not explain under what law of attraction these particles become aggregated. His theory totally failed in accounting for the formation of crystals which have a tetrahedral cleavage, inasmuch as tetrahedrons will not fill space.

" Dana considers the molecules, in the first system, to be spherical and possessed of six poles or centres of force, situated at the extremities of three rectangular axes; in the other systems these sphere become spheroids or ellipsoids. By means of this hypothesis he satisfactorily explained the cubical and prismatic formations, and pointed out, like Haüy, how the secondary forms will result from certain decrements at the edges or angles.

" He also accounted for the occurrence of twin crystals by supposing that two molecules may unite at a point of equilibrium between two or three poles. He did not, however, show why decrements take place, nor is it possible on his hypothesis to explain how different cleavages can exist in the same system. His ideas are directly borrowed from Sir D. Brewster, who thus expresses himself:—' The phenomena of cleavage, and of hemitrope forms, would clearly indicate that the inte-

grant molecules are spheres, each having six poles on its surface, and it is owing to the different degrees of force possessed by these poles that the different cleavages are due.' In this he is clearly in error, for no matter with what cleavage we divide a cube, we will eventually separate every pole from every other.

"I will, in this paper, confine my observations to the first system, but it will be readily perceived that they apply (*mutatis mutandis*) word for word to the other systems.

"The cleavages are of three kinds, cubical, octahedral, and dodecahedral; the cubical we have already explained; the octahedral formation will arise if each spherical molecule have twelve poles on its surface, whose position is given by the intersections of four great circles, having the same inclination and relative position as the faces of the tetrahedron; the form which they will assume will be the same as Wollaston propounded.

"If each layer of molecules be deficient by one row, planes will appear on the edges, which planes belong to the cube; we have thus got a compound form consisting of the cube and tetrahedron, or in other words, we have a cube with half its corners replaced by planes. By other decrements at the edges, or corners, we can explain all forms of the first system, except hemihedral forms with parallel faces, which never combine with forms without parallel faces.

"Thirdly, the dodecahedral formation will result if each molecule be a sphere with eight poles on its surface, situated with respect to each other in the same positions as the angles of a cube; as can be very easily demonstrated.

"Any crystal will of course cleave in whatever direction the least resistance is met with. Thus in the cubical formation the cleavage is cubical because by such division we separate each molecule from one adjacent molecule only, whereas if we divided it in any other direction, we would have to separate each molecule from two or three others. In the octahedral

formation the cleavage is octahedral, for such cleavage overcomes the attraction of each molecule to three others, while any other would have to overcome the attraction of at least four. And in the dodecahedral the cleavage is in like manner parallel to the faces, as this cleavage destroys the cohesion of two poles, while the two other possible cleavages would destroy the cohesion of three and four respectively.

"With respect to the cause of decrements, they will evidently result from the loss of polarity in the external molecules, and this loss is what we would have every reason to anticipate; for if we consider the attraction of the particles to arise from the attraction of a fluid contained in them, and that this fluid is only held in its place by a certain coercive power of the molecule itself, as is the case with a magnet, it will follow, that as the crystal increases in size the combined attraction of the whole fluid will draw from the extreme molecules such fluid as they may contain, and thus they will lose their polarity.

"Thus, if the time which elapses while a layer of molecules is being laid on a cube, is equal to that which elapses while the polarities of the corner molecules is being removed, octahedral faces will appear; and in a similar manner we can explain all the other cases.

"In this theory we must of course suppose the particles of the fluid to be infinitely smaller than those of the crystal."

Monday, May 28th, 1855.

THOMAS ROMNEY ROBINSON, D. D., President, in the Chair.

Dr. Aldridge read a paper on the nature of the precipitate which occurs in the preparation of alkaline phosphates.

"The composition of the precipitate produced by the addition of the carbonate of potash, soda, or ammonia, to the acid liquor made by digesting dilute sulphuric acid upon bone ashes, does not seem to have been very carefully studied by chemists.

"M. Dumas considers this precipitate to be carbonate of lime. He says in his 'Traité de Chimie appliquée aux Arts,' tome ii. p. 318 :—'On l'obtient en versant, dans une dissolution de phosphate acide de chaux du carbonate de soude en dissolution, jusqu' á ce que la liqueur soit alcaline; ce qui donne lieu à un dégagement d'acide carbonique et à *un précipité gélatineux de carbonate calcaire.*' In this statement he is followed by Sir Robert Kane and the majority of British compilers. Berzelius regarded it as a mixture of phosphate of lime and a little carbonate. He says in his 'Traité de Chimie,' seconde édition, Française, 1847, tome iii. p. 214 :—'La liqueur acide, qui contient de l'acide phosphorique, du phosphate calcique et un peu de gypse, est décomposée par le carbonate sodique, de manière qu'il se précipite du *phosphate calcique, mêlé avec un peu de carbonate*, tandis que le phosphate sodique, accompagné d'une petite quantité de sulfate, reste en dissolution dans la liqueur.' Gmelin considers it to be phosphate of lime and magnesia. In the translation of his 'Hand-Book,' published by the Cavendish Society, 1849, vol. iii. p. 91, it is said, speaking of the ordinary phosphate of soda :—'It may be prepared by adding carbonate of soda to the aqueous phosphoric acid obtained from bone ash, the liquid being kept at a boiling

temperature, and the carbonate of soda added as long as effervescence continues; filtering to separate phosphate of lime and magnesia, boiling the liquid down, and leaving it to crystallize.'

"I will not occupy the time of the Academy by proving that the assertion, that this precipitate is carbonate of lime is utterly erroneous; the most trifling examination shows that it is a phosphate of lime of some kind. Berzelius and Gmelin thought, as is evident from the extracts quoted, that it was identical with bone earth, for they never apply the simple name of 'phosphate of lime' to any other compound; and they were probably led to this opinion by the knowledge of the fact, that when bone earth is dissolved by nitric, hydrochloric, or acetic acids, it is precipitated by an alkali unchanged. This is easily intelligible by an equation:

$$PO_5\ 3\,Ca\,O + 2\,Ch\,H = PO_5\ Ca\,O\ 2\,HO + 2\,Ca\,Ch.$$

It will be here seen, that a mono-phosphate of lime and chloride of calcium are formed (supposing hydrochloric to be the acid employed), and both these dissolve. Let an alkali (ammonia) be now added, and the following will take place:

$$PO_5\ Ca\,O\ 2\,HO + 2\,Ca\,Ch + 2\,NH_3 = PO_5\ 3\,Ca\,O + 2\,NH_4\,Ch.$$

The two equivalents of lime which had been abstracted and decomposed by the hydrochloric acid are re-formed, and, going back to the mono-phosphate, regenerate bone earth.

"But it will be seen that this reproduction of the bone-earth is due to the whole of the lime being retained in the solution; the case is different when sulphuric acid acts upon bone ashes. Döbereiner and Berzelius have shown that the action of sulphuric acid on bone earth varies according to the quantity of acid employed; but in any case the lime subtracted by the acid is rendered insoluble, and thus removed from the liquid. A possible decomposition is the following:

$$2(PO_5\,3\,CaO) + 5\,SO_3\,5\,HO = PO_5\,3\,HO + PO_5\,CaO\,2\,HO + 5(SO_3\,CaO),$$

and the results would be free phosphoric acid, mono-phosphate of lime, and sulphate of lime; but the latter is insoluble, or nearly so, and the filtered liquid would therefore only contain phosphoric acid and mono-phosphate of lime. If to this solution, ammonia or any other alkali were added, the most probable reaction might be thus represented:

$$PO_5\,3\,HO + PO_5\,CaO\,2\,HO + 4\,NH_3 = PO_5 + 2\,NH_4O + HO + PO_5\,CaO\,2\,NH_4O.$$

The free phosphoric acid would form the ordinary phosphate of ammonia, and the mono-phosphate would, by appropriating two equivalents of ammonia, become an ammonio-phosphate of lime. I say this would be the most likely decomposition, because, in the absence of the two equivalents of lime requisite to make bone earth, the mono-phosphate might be supposed to prefer oxide of ammonium to water, the only other available basic element.

"By digesting dilute phosphoric acid upon bone ashes, and filtering, I obtained a solution of mono-phosphate of lime with free phosphoric acid. This solution precipitated upon the addition of an alkali; but the precipitate differed from bone earth by being easily fusible before the blow-pipe flame.

"Saussure says, that bone earth fuses at 370° Wedgwood, but I never could produce the slightest cohesive effect on it by subjecting it to a gas jet urged by the blow-pipe. The fusible precipitate thrown down by an alkali from an acid solution of the mono-phosphate differs in properties according to the alkali employed.

"When precipitated by ammonia it fuses into a transparent glass bead in the outer flame, and bubbles violently; it becomes white and opaque when kept long in the inner flame: in fact, it acts exactly similar to metaphosphate of lime, which no doubt it is, the ammonia being driven off by the heat. The

precipitate produced by potash, or carbonate of potash, is also fusible; but the bead is white and opaque, both in the outer and inner flames; it does not bubble, and the flame becomes coloured strongly violet. The precipitate caused by soda resembles that produced by potash in its behaviour before the blow-pipe, with the exception that the colour of the flame is the characteristic yellow proper to soda compounds. I think there can be very little doubt but that these are double salts.

"Upon adding the alkalies, or their carbonates, to the acid liquid produced by digesting diluted sulphuric acid upon bone ashes, exactly similar precipitates are thrown down. These are all fusible, and as the beads possess precisely similar characters to those I have described, I need not now repeat them. If the liquids are mixed cold, after the sediment has been removed by deposition or filtration, a further precipitation will happen upon boiling in the case of alkaline carbonates, but this second precipitate behaves before the blow-pipe in a similar manner to the first.

"In conclusion, I submit to the Academy, that the precipitate that occurs in the preparation of alkaline phosphates is not, as has been hitherto stated, carbonate of lime, or phosphate of lime, but is a double phosphate of lime and of the alkali employed."

Dr. Anster read a Paper by the Rev. James Wills on the subject of Dreams.

After some general observations on the peculiar difficulties of the subject, the author proceeded to give a conjectural statement respecting the probable origin of dreams, founded on the received theory of the nervous system.

He then entered into some explanations, in which he traced the mental operations in dreaming, to the laws of association, as stated in his former Papers.

The author next proceeded to explain two conditions by which the peculiar character and direction of these operations

is mostly governed. Firstly, the entire suspension of the judgment; and secondly, the generally *visible* character of the ideas in dreaming. From these two conditions, the author explained the ordinary phenomena of dreams.

The author next proceeded to apply the foregoing considerations, together with the principles laid down in his former Papers,* to the explanation of the memory of dreams, and other incidental circumstances commonly observed; and concluded by the remark, that the statements which he had been enabled to offer possessed the value of adding confirmation to those advanced in his former Papers.

The Rev. Professor Graves, D.D., read a paper on the Ogham inscriptions appearing on a sculptured monument found at Bressay, in Shetland.

The inscriptions are thus deciphered by Dr. Graves:—

1. CRUX': NATDODDS : DATTR : ANN.

That is, *The Cross of Natdodd's Daughter here*,—the final word *ann* being in Irish, the rest in Icelandic.

2. BENRES : MECCUDROI : ANN.

That is, *Benres, of the Sons of the Druid, here.*

NADDODD, according to the Landnámabók, was a Viking, or pirate, who in general resided in the Færoe Islands. In the course of a voyage between them and Norway, being carried out far to sea westwards by a storm, he accidentally discovered Iceland in the year 861. So far as Dr. Graves has been able to ascertain, after a careful search, no other individual of the same name is mentioned in the Scandinavian annals or sagas. This NADDODD had a grandson, BENIR, whose name appears in the second inscription under the Latinized form of BENRES.

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* Transactions, vols. XIX., XXI., XXII.

In illustration of the use of the tribe-name, MECCUDROI (filiorum Druidis), Dr. Graves observed that BENIR had a daughter named HILDIGUNNA, who was reputed to be a witch, and to whose supposed powers of witchcraft allusions occur in a story preserved in the Landnámabók.

Adamnanus, in his 'Life of St. Columba,' mentions a robber named ERC MOCCUDRUIDIS, who lived in the island of Colonsay.

There are some peculiarities in the Ogham writing which deserve notice.

It contains the diphthongal character for *oi*, which is given in the alphabets, but does not appear on any monument that Dr. Graves has examined.

The Ogham strokes are all drawn with reference to a medial or stem line. Instances of this in monuments are rare, the edge of the stone being almost always used for the same purpose.

The words are separated by pairs of points (:), one at each side of the stem line. The same interpunctuation is common in Runic inscriptions.

The sculptured faces of the stone present crosses with interlaced ornament, figures of bishops with their croziers, and other details similar in character to the Irish monuments of the ninth century.

Monday, June 11th, 1855.

GEORGE PETRIE, LL. D., Vice-President, in the Chair.

Sir William R. Hamilton commenced the reading of a Paper on some symbolical extensions of quaternions, and especially on a theory of associative quines.

2. Sir William R. Hamilton also commenced an account of some geometrical applications of his theories, especially as founded on the notion of the anharmonic quaternion, and as leading to an enlarged conception of involution, not merely in one plane, but on a sphere, and generally in space.

Dr. Allman drew the attention of the Academy to a peculiar organic production, forwarded by Dr. Harvey from Western Australia. Its nature is very obscure. Microscopical examination reveals a structure which would appear to indicate the true relations of the production in question to be with the algæ, and Dr. Allman, therefore, preferred placing it provisionally in this group. He named it, in accordance with the suggestion of Dr. Harvey, *Callwellia insignis*.

The following donations to the Museum were presented:

1. A leaden avoirdupois pound weight, found near Maynooth. It is stamped with the letters I * S, surmounted with a crown: presented by His Grace the Duke of Leinster.

2. A very beautiful stone ring found at the bottom of a heap of stones, called a Danish fire-place, or lime-kiln, in the townland of Muckross, county of Fermanagh, in May, 1855: presented by F. W. Barton, Esq.

3. A bronze brooch, retaining portions of white and red enamel: presented by Rev. Charles Graves, D. D.

MONDAY, JUNE 25TH, 1855.

THOMAS ROMNEY ROBINSON, D. D., PRESIDENT, in the Chair.

HIS EXCELLENCY THE EARL OF CARLISLE, Lord Lieutenant, attended the meeting.

On the recommendation of the Council, it was Resolved to place £50 at the disposal of the Council, for the purchase of Antiquities.

George Petrie, LL. D., read an account of the ancient shrine or cover of the Gospels of St. Molaise.

J. F. Waller, LL. D., read a paper on the revival of Italian literature in the fourteenth century, especially in relation to Dante, Petrarch, and Boccaccio.

Robert Mallet, Esq., read a paper on the bursting of ordnance when firing heated shot.

The Rev. Dr. Todd read the following paper by the Rev. Dr. Hincks on certain animals mentioned in the Assyrian inscriptions:—

"It may be questioned whether there be any two branches of human knowledge between which it would be safe to say that no connecting link could possibly exist. It is, at all events, certain, that studies which appear at the first glance to have nothing in common, have been often found capable of rendering valuable assistance to one another. And it is no small advantage that a society like the Royal Irish Academy possesses, the meetings of which are attended by persons who are engaged in all manner of dissimilar investigations,

that they who have applied themselves to the extension of one branch of knowledge may not only be encouraged to carry forward their exertions by the approbation of those who have applied themselves to other branches, but may occasionally derive from them valuable assistance.

"The decipherment and the interpretation of records contained in a lost language seem at first to have no possible connexion with zoology; and yet the names of animals may occur in those records, and statements may be made concerning them, which may perhaps enable the zoologist to say which of the animals now existing in the country spoken of were designated by these names; or, it may be, to pronounce that animals must have existed there formerly, which are now no longer to be met with—even as the wolf and the beaver have disappeared from the Fauna of Great Britain, and the dodo from its last dwelling-place in the entire earth.

"In the present paper I propose to treat of the animals mentioned in the Assyrian inscriptions; and I hope that the knowledge of zoology possessed by some of those who may hear it read will enable them to throw light on points which mere philological research has left in obscurity.

"There is much greater difficulty in determining what animals were designated by Assyrian names than by Egyptian ones; and that for two reasons. The Egyptian sculptures present to us many representations of animals, with their hieroglyphical names over or beside them. When these names, therefore, are met with in ordinary Egyptian texts, it is known what animals they denote, even if no representation of the animal should follow its name; which, however, it very frequently does. On the other hand, the few determinatives which accompany the Assyrian names of animals bear no resemblance to them; and, consequently, do not indicate at all what the animals were. The Assyrian sculptures also very seldom contain representations of animals, accompanied by names which we can feel certain of belonging to them. In

fact, the sculptures which surmount, or intervene between the parts of a column of Assyrian writing are wholly independent of that writing; having as little relation to its contents in ordinary instances, as the illuminations of the capital letters in a mediæval manuscript have to the passages which those letters commence.

"The obelisk first found at Nimrûd, which is now in the British Museum, contains several representations of animals, the names of three of which are certain. There is an elephant called *alab*, or *alap;* a name which is perhaps compounded of the Arabic article and the Egyption *abu*, the Latin *abur*, and the Sanscrit *ibhas*, as Benary thought that the Greek ἐλέφας was compounded; but I incline to the opinion of Ewald and Rödiger that the Hebrew word for elephants, חַבִּים, *habbim*, stands for *halbim*, of which *halab* would be the singular. The Assyrians had no means of distinguishing *halab* and *alab*. This word has been connected by Ewald with the Sanscrit *kalabhas*, which also signifies an elephant: the *as* in this word is the nominative termination.

"Camels with two humps are figured on the same obelisk in two places; and they are in both instances called '*habba* whose humps are double.' The word *habba* has a determinative character prefixed to it, which appears to denote beasts of burden; it is placed before the names of all animals of the horse kind. I believe that *habba* stands for *halba;* just as the Hebrew *habbim*, according to Ewald, stands for *halbim;* that it is the plural of *halab;* and that this word, when it stands alone, signifies an elephant; while the determinative of beasts of burden prefixed to it gives it the sense of camel. The *halab* in this secondary sense was the dromedary, or Arabian camel; and when the Bactrian camel was spoken of, the explanatory words above mentioned, 'whose humps are double,' were required to be added. This was, however, not the only Assyrian word for the camel. In different copies of the inscription of Sargon, in which he records the tribute or pre-

sent made to him in his seventh year by the King of Egypt, the Queen of Arabia, and the Amir of Sabæa, the word *habba*, with the determinative prefix already mentioned, is interchanged with *gammal;* and the latter word frequently occurs in other inscriptions. It is obviously of the same origin with the Hebrew and Arabic word from which, through the Greek and Latin, our own word 'camel' is derived. The only other animal represented on the obelisk, both the name and the figure of which I have been able to ascertain, is the horse. The Assyrian name of this animal consisted of two characters preceded by the same determinative as that in the name of the camel. The first of these has several different values. It might be read *kurra*, but I think the more probable reading is *satra*. To this would correspond a Hebrew, Aramæan, or Arabic word, *hatar;* for in all these languages *ha*, *hi*, and *hu* correspond in the pronominal forms and the verbal performatives to *sa*, *si*, and *su*, of the Assyrian. I am not aware that this word occurs in any existing writing in any of the languages I have mentioned; but it is the Egyptian word for 'horse;' and the Egyptians certainly obtained this animal from their Asiatic neighbours, from whom they, no doubt, took its name also. It is an established fact that horses are never figured, or even mentioned, in the earlier Egyptian inscriptions. We have, therefore, strong presumptive evidence that in some of the dialects of Palestine, long prior to the Exodus, and indeed to Jacob's descent into Egypt, the name *hatar* must have been applied to the horse; and this leads me to prefer *satra* to every other possible reading of the Assyrian word.

"The word for 'horse' being known, that of another word which is never met with but immediately after it, and in intimate connexion with it, immediately follows. It necessarily signifies 'mares.' To establish this, I need only cite a single passage. In the 16th line of Bellino's cylinder, Sennacherib speaks of having taken '208,000 men and women,

7200 horses and mares.' It can mean nothing else. The name consists of the same determinative sign as before, followed by characters which I read *susim*, or *susiw*. The reading of the last syllable is uncertain; but I connect the word with the Egyptian *sesem*, which agrees both in its signification and in its radical letters. The relation of the word to the Hebrew סוּס, *sûs*, appears to me doubtful, though an attempt has been made to connect them. The last radical of the Assyrian and Egyptian words is wanting in the Hebrew; the latter language does not assign to *sûs* a feminine signification; and I am by no means certain that the Hebrew *Samekh* is ever represented by the Assyrian *s*.

"In two passages on Bellino's cylinder, we have four animals in sequence, the first, second, and fourth of which are the horse, the mare, and the camel: all whose names are preceded by the determinative already spoken of; while the third is represented by this determinative alone. In the passage in the sixteenth line, where 7200 horses and mares are said to have been taken, 11,112 of this third animal and 5230 camels were taken. I cannot think of any animal but the ass, which this ideograph can represent. This was the beast of burden first used, and, therefore, likely to have been symbolically represented, and to have had its symbol prefixed to the names of other beasts of burden; and it could scarcely have been omitted from a list of captured animals, which, however, it would have been if this ideograph did not express it. I regard the value of the character as denoting 'an ass' nearly certain; but I am uncertain how it was pronounced. A fourth word, to which this character is prefixed as a determinative, occurs in an inscription of Tiglath-pileser II., the contemporary of Menahem and Rezin (B. M. 68. 2). The word is *anaqâtiñ*, which occurs in the second Targum of Esther, i. 2, with the meaning, 'she camels.' There can be no doubt that this is the meaning here, as the determinative of females precedes that of beasts of burden, and as the word *habba*, 'camels,'

stands next before it. A fifth word, preceded by the same determinative, follows, which necessarily signifies either a foal generally, or the foal of a camel in particular. The second character in the word is different in two different copies of the inscription, and neither copy appears to be correct. This renders doubtful the second consonant in the word. I read it *zukkari*, taking it for a puhal form of the root *zakar*, 'to beget;' a signification of the root which has hitherto been considered doubtful, but which the word before us seems to confirm. The passage in the inscription terminates a sentence in this manner:—'Oxen and sheep, camels, she camels with their foals, I received.'

"A seventh word to which this determinative is prefixed is *parriñ*, which occurs in the seventh line of the inscription on Bellino's cylinder, where the booty abandoned by the Babylonians, and captured by the Assyrians on the actual field of battle, is mentioned. It consisted of chariots, waggons, horses, mares, asses, camels and *parriñ*, which I take to be put for *pardiñ*, and to signify 'mules.' The Assyrians assimilated adjoining consonants to a very great extent; and when we find *anna* for *anka*, 'tin' or 'lead,' and *gallu* for *gadlu*, 'great,' we cannot be surprised at *parriñ* for *pardin*. Mules are frequently represented in Assyrian sculptures.

"An eighth word occurs in a fragment of the Annals of Tiglath-pileser II. (B. M. 52, 2nd part, 11). We have here 'horses, *pariiñ*, oxen,' &c., enumerated as a tribute or spoil. It is possible that this may be a modification of the preceding word; but I rather think it means 'asses,' corresponding to another Hebrew word *pere*, פרא.

"In the sculptures from the North-west Palace at Nimrûd the Assyrian king is represented hunting and killing wild bulls and lions. In the pavement inscription from the same palace, where he relates his exploits, he says that he killed forty of one kind of animals, and took eight alive; of another he killed twenty, and took twenty alive. The name of the first kind

begins with a character, which, when it stands alone, is very commonly used in the inscriptions. It occurs as part of the booty taken from the different conquered nations, following horses, when these are mentioned, which it always exceeds in number; while it is taken in much smaller numbers than another animal which follows it. I cannot doubt that this character signifies 'an ox;' and it seems to be prefixed as a determinative to the following character *av*, which may signify 'a buffalo,' or 'wild bull.' A similar word, determined by the figure of an ox, occurs in the Egyptian inscriptions. Its precise signification has not been ascertained; Mr. Birch, in the vocabulary given in Bunsen's work, interprets it as 'a cow;' but there was another word in common use, of which this was certainly the signification.

"An obelisk which has been lately brought to the British Museum belonged, I believe, to the same king, the builder of the North-west Palace. I have only seen a rubbing of one of its sides. In it, the word which I have translated 'buffaloes' occurs without the determinative sign. The king says that he killed all those on Harajiq, and on the sides of Lebanon, that were of larger size, carrying away their calves, and (if I be right in interpreting the next word according to the Arabic) keeping their females in confinement. Though I think there is good reason to think that this animal was a buffalo or bison, it is never used to express any of the stone objects which the Assyrian kings erected at their gates. The word for 'bull' must have been different.

"The determinative of this word, which, when it stands alone, signifies oxen generically, is followed by different groups, all of which must signify 'sheep, goats,' or these two kinds of animals in common. Sometimes a word stands alone, which is evidently the Hebrew צאן, 'a flock,' though the vowels are different from those expressed by the Masoretic punctuation. To this a determinative is generally, though not always prefixed; namely, the character which has the phonetic value *lu*. I take

this word, with or without the determinative, to signify 'sheep and goats,' including both species. The determinative, however it was read, when it stands alone, seems to signify sheep; and another word, the plural of which is often joined with its plural, probably signifies 'goats.' In the pavement inscription at Nimrûd, this pair of words seems used as equivalent to *chi-ïni*, צאן.

"The word which I interpret lion consists of three characters, whose ordinary values are *mal*, *sir*, and *khu*. It may be considered as certain that all these are not their values in this group; but I have no idea how the Assyrian group should be read. It is probable, however, that some among the tablets of interpretation that are in the British Museum may solve this enigma.

"I believe that 'bull' is denoted by a group of which the ordinary values of the characters would be *ur* and *makh*. The first of these seems to be a determinative, and the second has very probably some other value in this combination.

"Other animals are mentioned, on which I do not feel that I can throw any light. I confine myself to two, which it requires more knowledge of natural history than I possess to identify.

"The first is named the *nakhir*, which, according to the Hebrew value of the root, would signify 'the snorter.' It is mentioned three times in the Assyrian inscriptions that I have seen, and in three different connexions; but they are all in inscriptions of the same king, the builder of the North-west palace at Nimrûd. At the end of the tribute of the maritime cities of Syria, Tyre, Sidon, Gubal, &c., he mentions 'teeth or tusks of the nakhiriñ, the produce of the sea.' He says, 'that he embarked in ships of the Arvadites, and killed the nakhir in the great sea.' The noun is here in the accusative singular definite, which would seem to imply great rarity. He speaks of the nakhir much in the same way as the Americans speak of 'the sea serpent.' Lastly, he speaks of setting up

at the gates of a palace (at Kaleh Shergât, as I believe) two Nakhirin̄, along with six bulls of stone, and other objects of different kinds of stone. It would seem from this that it was not stone representations of these sea monsters which he set up, but the skeletons of the actual animals; for it is scarcely credible that their skins were preserved. Now what cetaceous animal, or fish, could be found in the Levant, which would satisfy these statements?

"The other animal to which I wish to draw attention is one which is very frequently mentioned; and I am inclined to identify it with the reem of the Bible, and to suppose that it represents a species which does not now exist. At any rate, I think it cannot have been any of the animals which are now living in Syria.

"The name is composed of two characters, which it would be most natural to read *amtsi*. I, however, distrust this reading, and suspect that one of the characters, or the combination of the two, had some different value, which may perhaps be learned from a tablet.

"These animals are repeatedly named in the inscriptions, where the tributes of the different nations are mentioned. Their teeth or tusks (as I interpret the word which generally precedes them, and which is also used of the nakhir) were given by many people, and especially by those in Syria. Among the spoils which Esarhaddon took from the King of Sidon, he mentions skins of amtsi as well as teeth of amtsi. These teeth were also used in ornamenting chariots and other objects, and a kind of wood is mentioned which was used along with them for this purpose. Looking to similar passages in the Egyptian inscriptions, it is natural to translate these terms by 'ivory and ebony.' These animals, whatever they were, lived in Syria, as appears not only from their skins and teeth being given in tribute from the countries there, but because the King of Assyria is mentioned as killing them there. After the account of his killing the nakhir in the great sea, and the

buffaloes, he proceeds: 'He slaughtered amtsi with his arrows. The amtsi that survived he captured and brought to his city Assur.' In another inscription he speaks of killing thirty amtsi; a preposition and noun follow, the signification of which are doubtful. I think the root is ישב, *yashab*, to sit or dwell; but whether the king means to say that he killed them from an ambush, or that they were at rest when he attacked them, I cannot say; nor indeed am I very certain that the root is what I have stated. In the same passage where these thirty amtsi are mentioned, he speaks of killing 257 of what I have translated buffaloes, with arrows, while driving in his chariot, and also 360 bulls with a weapon, which I suspect to have been the boomerang. From this it appears that the amtsi were, comparatively speaking, rare.

"I feel that an apology is due to the Academy for offering a paper on a subject on which I possess such imperfect knowledge. Still, however, it may prove interesting to some; and it may elicit observations from naturalists that may throw light on what I leave in obscurity."

Sir William R. Hamilton read a continuation of his Paper on some new geometrical applications of quaternions.

MONDAY, NOVEMBER 12TH, 1855.

THOMAS ROMNEY ROBINSON, D.D., PRESIDENT, in the Chair.

EDWARD WRIGHT, LL.D., was elected a Member of the Academy.

Dr. Petrie having, at the request of the President, reported the donation, by Mrs. Thomas Moore, of the Library of the late Mr. Moore:—

On the recommendation of the Council, it was Resolved, by acclamation:—

That the marked thanks of the Academy are due and are hereby given to Mrs. Moore, for her liberal and important donation to the Academy.

The President announced to the Academy that the annual Parliamentary grant had been increased from £300 to £500 per annum.

The Secretary to the Council read the following papers:—

On the Early Discovery and extensive Adoption of the Bissextile Intercalation; with a view to determine the nature of the ancient Year. By the Rev. F. Nolan, LL.D., F.R.S.

After some general remarks on the natural division of the year by the vicissitude of the seasons, the difficulty which the author aims at removing is stated. The hypothesis of those learned persons who have laboured to prove that the ancient year consisted but of 360 days is first described, and some objections to which it is exposed are specified. The antiquity and general reception of the quadrennial intercalation is then asserted, and declared to contain a refutation of the false assumption that a year of such limited dimensions could have

been employed, by the ancients, for practical purposes. The facilities supplied by the Julian Period, which Scaliger brought into the service of chronologists,—as determining the place and nature of the quadrienniums of the Julian year,—are then insisted on, with a view to the establishment of a standard, by a comparison with which the modes employed by different nations in intercalating the year may be estimated.

For the attainment of the object at which the author aims, he proceeds to distribute his subject into three parts; respecting:—1. The use and antiquity; 2. The order; and 3. The intercalation of the quadrienniums as employed in the equation of time by the principal nations of antiquity, which he regards as the Egyptians, Greeks, and Romans.

1. In this order the Egyptians are considered in the first place; and the authority of Manetho is cited to prove that they discovered the mode of intercalating the year as early as the time in which the dynasty of Phœnician shepherds governed the country. This statement is corroborated by Censorinus, who identifies the small canicular cycle with the quadriennium, of which he describes the length and intercalation. Occasion is thence taken to show how the small cycle of four years was determined by the heliacal rising of the star Sirius; and how the great cycle of 1460 years was constituted of 365 lesser cycles or proper quadrienniums. From the high antiquity of the great canicular cycle, that of the quadriennium, on which it was founded, is concluded.

The transmission of the quadriennium from the Egyptians to the Greeks is then traced, and exemplified in the Olympiads, which are proved from Censorinus to have consisted of quadrienniums properly intercalated. From the various traditionary and historical notices of these cycles, from the times of Iphitus, and previously, it is shown that they were used by the Greeks above 900 years before the Christian era.

From the observations which apply to the solar year, it is then shown in order, that according to the quadriennium,

thus generally adopted, the lunar cycles, devised by the Greeks, for measuring the course of time, were constructed. Conformably to the principle, it is shown, that from the shortest of 8 years devised by Solon, to the longest of 304 years devised by Hipparchus, they consisted of a succession of complete quadrienniums, and ended in an intercalation. The exception of Meton's cycle of 19 years is considered; and evidence is produced that even in it the quadriennium was not disregarded.

To the Romans the use of the quadriennium is traced after the Greeks, and exemplified in the lustrum; the antiquity of which is inferred from its institution by Servius Tullius, about 580 years before the Christian era. Having shown, from the testimony of Ovid, that the cycle was a quadriennium properly intercalated, the author passes to the reformation of the Roman calendar by Cæsar, and shows that his principle, which remains in use among ourselves, was adopted from the times of Cn. Flavius, by whom it had been divulged about 304 years before our era.

2. The author, after inferring from the preceding observations the establishment of the first point of inquiry, proceeds to the second, in which he undertakes to show that the quadrienniums thus used by those ancient nations preserved the order which they hold in the Julian Period. In commencing with the Egyptians, he first considers the constitution of the great canicular cycle as composed of a succession of the smaller cycles, and as previously shown by him to be proper quadrienniums. From the construction of the fixed year, by which the vague year of the Egyptians was superseded at Alexandria, B.C. 25, it is first shown that its quadrienniums exactly coincide in order with those of the Julian Period. The same result is deduced from a rule given by a scholiast on Theon, for determining the epoch of the great canicular cycle. While it is founded on a computation of the quadrienniums which composed that cycle, it ends in tracing its first year to that of the corresponding quadriennium in the Julian

Period. An error of circumstance in this computation is corrected, in a comparison of it with that of the proper epoch, and the same result is established; from which it appears that the order of the quadrienniums in the Egyptian cycle is precisely that which is assigned to those of the forementioned period.

In proceeding to consider the usage of the Greeks, the author commences with disposing of a difficulty which arises in identifying the Olympic years with the Julian, in consequence of the one having commenced in July, and the other in January. After pointing out the manner in which this difficulty admits of correction, he proceeds to show how the Olympiads are thus reducible, in their order, to the Julian quadrienniums, to which they in effect conformed. Commencing with the first year of the firstOlympiad, he thence concludes that what is true of it necessarily applies to all those Olympiads which succeeded. From the solar distribution of the year he thence turns to the lunar, and shows that the cycles in which the latter was equated were accommodated to the Olympiads. Having exemplified this point, in the oldest cycle composed of two quadrienniums, he proceeds to the cycles of Cleostratus and Harpalus, which he shows had their first year coincident with the first year of the Olympiad. The same observation is shown to extend to Meton's celebrated cycle, although its distribution into quadrienniums was disregarded by that astronomer with a view to its accommodation to the lunar revolutions. By Calippus, however, in his improvement upon Meton, the principle for which the author contends is fully recognised, his celebrated cycle of 76 years having been distributed into complete quadrienniums, and having its first year coincident with the first year of the Olympiad.

From the reformation of the Roman Calendar by Cesar, a correspondent result is deduced; the quadrienniums, as determined by him, having been necessarily identical with those of the Julian Period. This point is established from an investigation of the first year, which commenced with the epoch of

the reformation, and was that succeeding the consulship of Cesar and Lepidus. On being reduced to its proper place in the Julian Period, and its position in the solar cycle determined, it is found to be the first year of its sixth quadriennium; and, thus coinciding with the epoch of the Julian years, numbered from it in succession, it necessarily determines the quadrienniums derived from it to have been of the same character.

From the account of Cesar's reformation an evidence is deduced of the antiquity of the order assigned in his Calendar to the quadrienniums, as corresponding with those in the Julian Period. In tracing the usage to the times of Cn. Flavius, by whom it was divulged in the consulate of P. Sulpicius Severus and P. Sempronius Sophus, the author shows that it preceded, by 259 years, the date of Cesar's reformation. An example is thence elicited from Livy of the intercalation of the lustrum in the year B. C. 169; from whence it appears that the quadrienniums so termed were disposed in the order which they occupy in the Julian Period, as derived from the year as reformed by Cesar. To this example another is added, which is founded on an emendation of the text of Censorinus, as corrected from Pliny, and from which, if admitted, a like result follows—that from the reign of Servius Tullius to that of Vespasian, evidence occasionally appears of the succession of lustrums having conformed to the common order of the quadriennums in the Julian Period, although great license was used in departing from it on particular occasions.

3. In the third and last division of his inquiry the author proceeds, from determining *the year*, to ascertain *the day* of the intercalation, which, as falling in the Julian year on the 6th of the calends of March, corresponding with February 24, has acquired, from its being repeated at the end of the quadriennium, the name of bissextile.

After premising that by the sun's entrance into one of the tropes, or cardinal points—the natural place of the intercalation

is indicated, the year finding in one of those points a natural beginning, which is regularly computed from the intercalary day by which it is immediately preceded—the author proceeds to show that the intercalation could not have been thus suggested, or have been originally coincident with the sun's ingress into one of those points which divide the year into seasons. This position he proceeds to prove by contrasting the time of the intercalation, as received from tradition, with that of the equinox as occurring between the extreme dates of the construction of the Egyptian calendar, B. C. 1711, and of the Roman, B.C. 45. Within that period, in which the intercalation occurred at the close of February, the equinox traversed from April 6 to March 24, according to the computation of these dates by the Julian year anticipated. Having shown that the same conclusion must be formed of the four tropes of the year, as identified by Sosigenes with the 8th of the Kalends of April, July, October, and January, whereas the intercalation was fixed for the 6th of the Kalends of March, it is thence decided that it could not have originated from any such coincidence.

The author, following up a suggestion of Eudoxus, preserved by the astronomer Geminus, by which the natural division of the year by the tropes is associated with the festival of the Isea, thence assumes that it discloses the probable grounds on which the day of the intercalation was chosen. After investigating the day on which the festival was held, and reducing the date of it, in the vague year of the Egyptians, to the coincident date of the Julian, he determines that in the year B.C. 1904, to which the epoch of the Egyptian calendar must be referred, the Isea fell on February 26. From this extraordinary coincidence in that remarkable year, he concludes that it discloses the original day of the intercalation, and the grounds on which it was chosen by the Egyptians. He thence takes occasion to prove the conformity of the festival with the time of the harvest in Egypt, at which it was

observed; and, by making a necessary allowance for the difference between the state of agriculture in those primitive times and the present, and between the productiveness of the climate in Upper and Lower Egypt, he proceeds to account for the difference of about 14 days, by which the ancients and moderns appear to have disagreed in the time of keeping harvest, as determined from the vernal equinox, which it has preceded about 24 days in all ages.

In confirmation of his views on this subject, the author refers to two Egyptian memorials, one of which is contained in the ancient hieroglyphic ritual, and the other in the circular zodiac of Tentera, which is at present in Paris. From the one he deduces an evidence that the division of the quadriennium, by the entrance of the sun into one of the tropes, was recognised by the ancient Egyptians, the diurnal and nocturnal ingress being expressed by a significant hieroglyphic. From the other he shows that the remarkable epochs when the great festival of Isis, in the retrogression of the great canicular year, coincided with those points of the horizon from whence the seasons take their beginning, were no less plainly expressed and happily indicated.

In proceeding from the consideration of the Egyptians to that of the Greeks, the author commences by observing the differences which arose from the substitution of lunar cycles for solar in the equating of the civil year to the latter. After premising that the reconciliation of those differences is to be sought at the close and commencement of the cycles, where the equation to solar time was applied, he proceeds to show that at these points they give sufficient indication of having been formed or deduced from years which preserved the original intercalation. He exemplifies this assumption in the ancient tetraeteris which had preceded the lunar cycles in Greece, and he establishes it from that of Solon and Cleostratus, which began on February 18; and was thus equated in the proper year and month, and within a few days of the original and

proper intercalation. Having thence taken occasion to explain and account for the departure of Meton and Calippus from the ancient practice, in their endeavour to render their cycles conformable to the lunar revolutions and first year of the Olympiad, he produces evidence from the ancient Delphic quadriennium, and the Pythiads, which took the intercalation on February 27, that as inquiry is carried back to remote ages, the evidence increases that such was the original and proper day of the intercalation.

In the practice of the Romans, which the author considers in its order, there are fewer difficulties; the intercalary day having been identified with February 24 in the reformation of the calendar by Cæsar, who in his choice of that day adhered expressly to ancient immemorial usage. Some diversities in the choice of the day, in which the Pontiffs were allowed and exercised a discretion, are then explained; and the consequent irregularities to which they gave rise in the year of confusion which called for the correction of Augustus, are described in order; and the exceptions, so far from weakening the general conclusion, serve to establish it, and confirm the assumption that the original day of the intercalation was preserved in Cæsar's reformation.

From the consideration of the fixed year of the Egyptians, generally known as the Alexandrian, a like inference is drawn. As a continuance of the ancient or vague year,—it necessarily took its beginning from the day on which the old year which it superseded ended. Although, in compliment to Augustus, the neomenia was chosen from the month of August, to which he gave its name, the intercalation was effected in the simplest manner, and that least likely to disturb the order which enjoyed so ancient a prescription. In its transfer from the middle to the beginning of the first year of the new era, it retains some evidence of the day of the intercalation having originally fallen on or near February 25. Such was the date of the month Phamenoth 1st, by which the Egyptian year is

precisely divided; and from which the intercalation was transferred to Thoth 1st, with which the new year always commenced in Egypt.

A like inference is deduced from the era of Nabonassar, as having its neomenia coincident with February 26, the concurrence of that day with the time of the intercalation having led, amongst other causes, to its institution. The assumption derives confirmation from the Tentera zodiac to which we formerly alluded, and which was discovered in a temple that appears to have had its foundation determined by the rising of Sirius, as observed by the eye when directed along its walls to the horizon. In the coincidence of so remarkable a phenomenon with the day of the intercalation, a sufficient cause for the erection of the temple at the celebrated era appears to be suggested. And the supposition derives no inconsiderable support from the monument raised in it; which, in the position assigned on it to Isis, in connexion with the cardinal points, marks out the precise time at which the temple was founded.

The last instance adduced by the author, in support of his theory of the ancient year, is taken from the calendar of the Mexicans, which serves less to prove its antiquity than its extensive adoption. It appears that at the time their country was discovered they had acquired a just notion of the length of the year, having been accustomed to compute the course of time by quadrienniums, exactly corresponding with the Julian, and, what appears truly astonishing, having the intercalation coincident with February 25, as in the Roman calendar. And this custom, which was accompanied with superstitious and barbarous rites, that prove it to have been derived from a different source than the Roman, we are assured on the highest authority, was common to all the polished nations of Anahuac, among whom the Mexicans were the principal.

After producing some concessions from the advocates of the ancient year consisting of 360 years, by which their opposition to the author's theory of an ancient year properly inter-

calated is neutralized, he brings his investigation to a close, in offering some remarks on the merits and usefulness of the Julian Period. Having so far established the antiquity, order, and intercalation of the quadrienniums, on which the year used by the nations that rank as classical is founded, he asserts their perfect conformity, in all essential points, to those incorporated in that great scale which has conferred such inestimable benefits on chronologists; and that, while it removes from them the reproach of measuring by a rule of which the dimensions are vague and indeterminate, furnishes them with an instrument by which the nicest computations may be made, and the most extraordinary discoveries effected.

On a Babylonian Tablet in the British Museum, by the Rev. Edward Hincks, D. D.

This paper contains a copy of a Babylonian tablet, of which the following is given as the translation:—"On the sixth day of the month Nisan, the day and the night were equal. Six intervals were the day; six intervals were the night. May Nebo and Marduk draw near (i. e. be gracious) to the king, the lord." Every word in the inscription is examined separately; and its reading in most instances, and its translation in all instances, are given. The *intervals* spoken of, each of which was equal to two of our hours, are shown to have been marked by the running out of water or sand; the root from which the word signifying such an interval is derived having the meaning "to fail." In the course of the paper the Babylonian ordinal, collective, and cardinal numbers are treated of, and the linear measures; various errors on these subjects being pointed out. In conclusion, the absence of a date for the year is accounted for by the supposition that the tablets of each year were placed in a compartment with wooden sides and bottom; which having decayed, the tablets fell to the ground and were mingled and broken. The date of the equinox recorded is shown to have been on the 27th March,

652 B. C.; the 22nd March being the first day of the Assyrian year.

The Secretary to the Council also read the following communication from John Barton, Esq., on a remarkable phenomenon observed on Lough Erne:—

"*Clonelly*, 23*rd October*, 1855.

"MY DEAR SIR,—I beg to call your attention to a phenomenon on Lough Erne, which is universally known to the inhabitants of its shores, particularly on the broad part of the lake,—viz. the working of the lake previous to a change of weather, either from wet to dry, or the reverse.

"As I am aware you know the principal names in the lower lake, I will take Lusties Islands as the centre, and I think the best part for an observer that had any idea of studying the matter to station himself.

"When the lake roars (as the phrase here is) on the east shores, it is a sign of wet; when the noise is on the west, of fine weather. On a calm day the noise of the lake is equal to a waterfall, and the swell comes like a ground swell of the sea, lashing each shore, as the case may be, either from the west for wet, or east for dry weather.

"I have been on the lake on a very fine day,—the lake as smooth as possible,—when all of a sudden a strong ground swell came on, apparently without a cause. In about an hour or so after, it rained very hard, still continuing calm. On the wide part, of course, the waves are larger; but inside the Bow Island an observer can notice this, but in a much smaller degree. From my notice having been attracted to this, I can perceive the same, in a smaller degree, in all small lakes. And I am of opinion, that in a smaller degree every body of water must be subject to the same agitation, although in small bodies the harder to perceive.

"A ground swell on the sea may be accounted for by agitation from any distance, though it may be doubtful. But

when the same phenomenon takes place on a small body of water like Lough Erne, that the eye can reach over, and see that for days together it is smooth and calm, and all of a sudden this ground swell takes place, it must be from either atmospheric pressure, or some other cause, certainly unknown to the unscientific inhabitants of this neighbourhood. I made inquiries when at Lough Neagh if the same phenomenon was observed there, and could not find that it was, which led me to think, that as Lough Erne was so much higher above the sea (150 feet) than Lough Neagh (40, I believe), this circumstance might make a difference in the agitation and noise, as it appears that the higher any lake is above the sea the more effect the wind has in raising its waves. In a breeze it may so happen that this phenomenon may take place in a greater degree in lakes of greater elevation. You mentioned that some similar phenomenon was observed in the Lake of Geneva. It appears to me that the same takes place in every body of water,—but so many scientific persons have lived on its banks, that they must have noticed it at once, and recorded it.

"I forgot to mention, that previous to frost the waves beat on the south shore, or Churchhill side, which is heard very faintly from our side (the north side).

"I hope you will excuse this, as it is merely the result of observation, and known to all the people in the neighbourhood of this lake.

"I am your's very truly,

"John Barton.

"*Rev. Romney Robinson, D. D.*"

NOVEMBER 30TH, 1855. (Stated Meeting.)

GEORGE PETRIE, LL.D., VICE-PRESIDENT, in the Chair.

THE Secretary of the Council read the following recommendation of the Council, and moved—" That the Academy do repeal the By-Law, Chapter VII., Section 6, viz.:—

" ' In case of the sickness or absence of any Member of a Committee, to be signified to the Secretary of Council, that Member of such Committee shall nominate a Member, *pro tempore*, out of the names which have been proposed by the Council to fill the Committees, and which have not been elected; the Member's nomination shall then be signified to him by the Secretary of Council; and in case the President shall approve such nomination, such Member *pro tempore* shall be vested with all the powers of a Member of Council.' "

Moved by Rev. G. S. Smith, D.D., seconded by J. M. Neligan, M.D., and—

RESOLVED—That the consideration of this question be adjourned to the Stated Meeting of the 16th March next.

The Secretary of the Council read a paper, by the Rev. George Salmon, on Reciprocal Surfaces.

" The object of this paper will be better understood by first stating the corresponding problems for plane curves, and the solution which has been given for them.

"If the *degree* (m) of a curve be estimated by the number of points in which it meets an arbitrary line, and the *class* (n) of a curve by the number of tangents which can be drawn to it from an arbitrary point, then it is known that the degree of the curve is equal to the class of the reciprocal curve, and *vice versa*, and that the latter is in general derived

from the former by the formula $n = m(m-1)$. But this led to the paradox, that if we formed by the same rule the degree of the reciprocal of the reciprocal, instead of falling back on the number m, as we plainly ought, we should obtain a much larger number $[(m^2-m)(m^2-m-1)]$. The difficulty was explained by showing that the degree of the reciprocal of a curve is diminished when the curve has multiple points; and the full examination of the subject showed that a curve of the n^{th} degree has in general a certain determinate number of points of inflexion and double tangents, each of which gives rise to a multiple point on the reciprocal curve.

"The corresponding problems for surfaces were, I believe, first investigated in a paper which I contributed to the 'Cambridge and Dublin Mathematical Journal' in the year 1846, in which I gave the first outlines of a theory, the completion of which I now lay before the Academy.

"In the following paper I first investigate the degree of the reciprocal of a surface of the m^{th} degree, and examine how that degree is affected when the surface has multiple points or lines.

"The first application of the theory is made to the case of developable surfaces. The reciprocal of a developable is a curve of double curvature, which is to be considered as a surface of degree (0). It furnishes then a test of the theory to examine whether it explains why, when the surface is a developable, this reduction takes place in the degree of its reciprocal. And this explanation is successfully obtained.

"I next show that a surface has a number of stationary and double tangent planes, whose points of contact lie on a certain locus, the degree of which is investigated. The surface has also a certain determinate number of triple tangent planes. Every one of these multiple tangent planes gives rise to a multiple point on the reciprocal surface.

"In the next place, having in the preceding section determined the number of multiple points and lines on the reci-

procal surface, I apply to it the general theory, and show how it is that the degree of the reciprocal of that reciprocal reduces to m.

"Finally, I apply the theory to the case of ruled surfaces, for which it is easy to see that the degree of the reciprocal is always equal to the degree of the surface, and I show how it follows from the general theory that this is the case."

The paper was referred to the Council for publication.

Parke Neville, Esq., presented some specimens of peat-moss, and part of a rope or cable, formed of heath, found about ten feet under the surface of the street, in an excavation made lately in St. Michael's Hill, opposite the western entrance of Christ Church, Dublin.

Monday, December 10th, 1855.

REV. SAMUEL HAUGHTON in the Chair.

The Rev. Joseph A. Galbraith made a communication on the subject of the barometric measurement of mountain heights. He laid before the Academy the results of ten measurements of the height of the Two-Rock Mountain, made by Professor Haughton and himself during the years of 1853, 1854, 1855, with the view of settling some dubious points connected with the use of the barometric formula. They commenced operations by measuring with the staff and level the exact height of the summit of this mountain above the floor of the magnetic observatory in the Fellows' Park, Trinity College. This height they found to be 1738·63 feet. With this standard Mr. Galbraith compared the heights calculated from the different barometric formulæ which have been proposed. The formulæ he computed from were as follows:

$$\text{I.}\quad H\,(\text{in fathoms}) = \left(1 + \frac{\theta}{492}\right) 10000 \times \log \frac{h}{h'}.$$

This is the formula commonly used in this country; θ being the mean temperature of the column, reckoned from 32°. In this formula no account is taken of the hygrometric condition of the air.

$$\text{II.}\quad H = \left(1 + \frac{\theta}{492}\right) 10000 \times \log \frac{h - f}{h' - f'}.$$

In this formula, which was proposed some years ago by Professor Apjohn, f and f' are the observed tensions of aqueous vapour at the two stations.

$$\text{III.}\quad H = \left(1 + \frac{\theta}{492}\right) 10000 \times \log \frac{h - \frac{3}{8} f}{h' - \frac{3}{8} f'}.$$

In this formula f is supposed to be the mean tension of vapour in the column. This modification of the formula was proposed by Mr. Rennie, in a paper read before the Academy, and which is now in course of publication.

The average result of the ten observations seemed to agree best with formula (I.); from which it would appear that the vapour in the air entered into the physical consideration of the question in so uncertain a manner, that, on the whole, it was safer to leave it out.

Mr. Galbraith stated that if proper precautions were used in the determination of the tension of the vapour at the two stations, it was not unlikely that formula (II.) would give results much more in unison with the levelled height than those he had already obtained.

By applying Mr. Rennie's modification, the heights are necessarily increased, and as the average height calculated from formula (I.) exceeded the true, formula (III.) should, on practical grounds, be excluded.

Mr. Galbraith made some observations on the coefficient 10000, and gave a full account of the various constants on which it depended.

The paper was referred to the Council for publication.

The following donations to the Museum were presented:

1. An iron stirrup, found in the river Boyne, at New Haggard Ford, above Trim; presented by Michael Odlum, Esq.

2. A token of Edward Marttin of Drogheda, found in a field at Moygaddy, county of Meath, near Maynooth; presented by the Duke of Leinster.

MONDAY, JANUARY 14TH, 1856.

THOMAS ROMNEY ROBINSON, D. D., PRESIDENT, in the Chair.

ON the recommendation of the Council,—

IT WAS RESOLVED,—That the thanks of the Academy be presented to His Excellency the Lord Lieutenant and Chief Secretary of Ireland, for the interest they have taken in the welfare of the Academy, in procuring from Government a grant of £150 for the purchase of the gold ornaments lately found in the county of Clare.

The Secretary read a letter addressed to the President by Henry Hennessy, Esq., M.R.I.A., on the causes of certain phenomena observed in Lough Erne.

"*Catholic University, Dublin,*
"*January* 1, 1856.

"MY DEAR SIR,—I have been reminded, by seeing Mr. Barton's letter on the phenomena observed at Lough Erne, in the Proceedings of the Academy, that I promised to communicate to you, in a letter, my views in explanation of the matter which I mentioned to you soon after the letter had been read.

"It is well known that in hilly regions the alternations of temperature between the high and low grounds produce currents alternately ascending and descending. Such currents have been specially studied by M. Fournet among the Alps. He points out how the action of descending currents in some places produces frost, so as to destroy young and tender plants in the valleys. In some quarters such a current is called '*loup de vent.*' It acts with great energy, and causes the thermometer to sink suddenly by 3 or 4 degrees centigrade (5° 4′ and 7° 2′ Fahrenheit).

"It appears in general that, among the Alps, the formation of such currents depends on the setting and rising of the sun. In proportion to the clearness of the sky at any locality, this law will be found to hold with more or less exactness, and, therefore, although established for the interior of the Continent, we cannot, *à priori*, expect to find it realized in the analogous phenomena which may be observed in this country. Considerable changes of temperature may take place in Ireland, from the variable brightness of the sky, and the influence of oceanic currents. We should, therefore, be prepared to find conditions arising, which would cause ascending or descending currents at periods of the day that would not be at all anticipated by the observations made among the Alps.

"I proceed to apply these observations to the phenomenon noticed by Mr. Barton. If we conceive an inland sheet of water, bounded by hills on at least one side, the alternations in temperature between the air at the top and at the foot of these hills will produce such currents as I have indicated. If the hills be very steep towards the lake, the upper masses of air will sometimes even flow over the escarpment in a kind of cascade, and falling downwards in a direction more or less inclined to the vertical, will ultimately strike the waters of the lake in the neighbourhood of the hills. The more the direction of the descending current approaches the vertical, the greater will be the pressure on the lake, and therefore its effect in producing waves. Whenever a breeze tends to propagate waves on the surface of a sheet of water, its effective action is due chiefly to the vertical component of the force with which it strikes the water. Very feeble currents descending vertically might thus produce greater disturbance on the surface of a lake than strong currents skimming it horizontally. Such vertical currents descending only close to the hills at one side of the lake would not be felt at the other. Thus, during perfectly calm weather, a heavy swell might be observed at one

side of the lake, from the action of a downward current at the opposite side.

"The fact that such a phenomenon has not been observed at Lough Neagh tends to confirm these views, for Lough Neagh is surrounded by flat shores, and is, therefore, not likely to be subjected to the action of vertical currents.

"I remember seeing, somewhere in the writings of Humboldt, a conjecture that the tides in the Lake of Geneva, called *seiches*, arise from variations in the atmospheric pressure at different parts of the lake. These variations are, no doubt, the results of such vertical currents, and suggest a mode of verifying the correctness of the views here put forward, if observers, furnished with barometers, resided on the opposite shores of a lake where the phenomenon has been noticed. I find that Saussure attaches great importance to the influence of vertical currents on the barometer. This, he remarks, is most likely to take place among the mountain gorges and funnel-shaped basins.*

"As the method of studying vertical currents by the variations of the barometer seems a little complicated, and too delicate for ordinary purposes, I have devised a wind-gauge which will indicate the existence of ascending or descending currents. It will also show the direction of the wind with regard to the points of the compass. I am surprised at not having already heard of some similar instrument in the hands of those who have paid attention to mountain winds. The instrument I have devised is not a measurer, but simply an indicator, and I expect to receive one in a short time from our philosophical instrument-makers in Paris.

"Believe me to be, my dear Sir,

"Yours very truly,

"Henry Hennessy.

"*The Rev. T. R. Robinson, D. D.*"

* Voyages dans les Alpes, tom. iii., p. 71.

The President read a paper on the luminous phenomena produced by the discharge of Ruhmkorff's induction apparatus in vacuo.

"Although this beautiful experiment has been carefully examined by several distinguished philosophers, whose results may be found in De Moncel's pamphlet, I hope I may be excused for calling attention to it; as in repeating it I have observed some facts which seem to require further elucidation, and which I wish to point out as deserving of notice to those who possess more perfect apparatus than I command.

"The Ruhmkorff which I use is of the smaller size, containing about 6700 feet of fine wire, and excited by one or two Grove's cells; its compensator is of thin sheet gutta percha, each of whose coated surfaces is 8 square feet; and the terminals of the secondary helix are occasionally connected with a Leyden jar of 1·25 feet internal coating. The air-pump is a make-shift, altered from one of the commonest kind; but on a principle which, with good workmanship, would act well.

"1. When the discharge takes place in the vacuum formed by exhausting common air from the receiver, or (as Grove calls it) the air vacuum, the appearances are well known. As I observed them, if the terminals are platinum points, 4 inches apart, and the gauge $0^{i}\cdot 10$, a star is formed at the positive one, pink, tinged with orange. From this darts a rich stream of violet light, crossed with dark bands, which are most distinct at its lower extremity; it seems to revolve on its axis, and is enveloped in an elliptic mass of faint yellowish light. It terminates at $0^{i}\cdot 7$ from the negative point, and about $0^{i}\cdot 5$ is completely dark; the negative terminal is wrapt in a coat of bright blue light, through which, by an optical delusion, the platinum *seems* red hot: round this is a dark space, then a yellowish envelope, and round this a purple haze. The appearances are nearly the same when the terminals are brass balls; with the addition that the negative ball is covered with green flames, owing to the combustion of the brass. Each of these consists of a speck of

white light surrounded by a green atmosphere. When the negative ball is removed, and a disc of varnished card, 2 inches diameter, screwed in its place, with the point projecting in its centre; a sheet of light spreads over the disc, doubling round it and enwrapping the stem. It is remarkable that whatever forms the dark bands, is effective here, covering the disk with bright rings, which, when the eye is in its plane, look like a succession of waves. In all these cases the stream, as was shown by Eisenlohr, is rich in those rays which produce Stokes's fluorescence; drawings or writings made on paper with acid solution of sulphate of quinine, which are invisible in common light, gleam out intensely white on a purple ground; and ornaments of Uran glass look strangely bright. Even the glass of the receiver becomes luminous under their influence. Sometimes, however, this does not occur, and the light of the stream is livid; in this case it will be found that oil from the collar of leather has been decomposed by the discharge. Of these phenomena the most notable are the rotation of the light, the dark bands, the discontinuity of the light near the negative terminal, its separate luminous envelopes, the anomaly of combustion taking place there rather than at the positive terminal, and the extraordinary quantity of fluorescent rays. These last might be supposed essentially inherent in the electric light; but it will be seen that they are due to the special character of the medium.

"2. Introducing into the receiver a morsel of blotting paper moistened with distilled water, the gauge could not be got below 0·4. The column of light was much narrower and brownish red; there were no bands which I could see, and scarcely a trace of fluorescence. The powerful effect of watery vapour in thus modifying the appearance of the discharge indicated the necessity of completely drying any gases experimented on, which was in all other cases but one effected by enclosing in the receiver a vessel exposing 8 square inches of sulphuric acid, and letting it absorb for twenty-four hours.

"In vapour of turpentine the stream was narrow and dull; fluorescence very faint. At each of the pointed terminals was an intense green star, even when they were platinum; and from the negative one red hot globules were projected, too obscure to be melted platinum, and therefore probably carbon from decomposition.

"In vapour of alcohol, gauge $= 0^{i}\cdot 7$, the stream, which (as in the other vapours) was much contracted, was blue, with a tinge of green. The terminals (balls in this instance) were covered with green sparks, which on the positive one at least do not depend on combustion of the brass. Here also was little fluorescence, and as there is no note of dark bands, I suppose they were not conspicuous.

"As air was present in these vapours, it may be concluded that the fluorescence actually observed is due to it, and not to the vapours.

"3. The receiver was filled with coal gas from a burner. The sulphuric acid probably absorbed some hydrocarbon from it as it became brown. It was exhausted to $0^{i}\cdot 08$. The light was livid white, giving the idea of an excess of the more refrangible rays, though the prism showed much red. There was not more fluorescence than could be explained by the common air with which commercial coal gas is often adulterated. It, however, exhibited the true nature of the dark bands; they are intervals between the luminous menisci of which the entire column of light is made up, the centre of whose curvatures is the bright point on the positive terminal from which the discharge breaks out. This structure is far more beautifully exhibited in—

"4. Hydrogen. It was obtained from Liege zinc and diluted sulphuric acid, and passed through solution of potassa. The terminals were, in the first case, the point with its card disk already described, and an inch ball. When the gauge was $1^{i}\cdot 15$ (the Ruhmkorff being excited by three Groves), the discharge passed as a crimson spark $3^{i}\cdot 5$ long and $\frac{1}{16}$ thick.

Round it was a faint envelope, in which were close dark bands, not traced in the spark itself. With gauge $0^{i}\cdot85$, they extended over all, about 50 to the inch, black and sharply defined. With $0^{i}\cdot07$ the appearance was superb, something like the sketch.

"There are about 25 of the menisci whose concentricity with the luminous point on the ball I verified by comparing them with circles drawn on paper, and placed behind the receiver; the lowest I estimated at $1^{i}\cdot25$ broad. Below the dark space the light doubled over the disc, but without rings, and then clothed the stem with its purple envelopes. There was no fluorescence, at least not enough to make the quinine drawings visible. This was repeated with ball terminals, exhausting the receiver four times successively, as often filling it with hydrogen, and leaving it as many days in contact with the sulphuric acid. The interval of the balls was three inches,

and one Grove was used. The discharge did not pass till the gauge was 0·70. The light was pale, greenish blue; the envelopes of the negative ball not blue, but reddish, yet no trace of fluorescence. The fine dark bands were seen as before, and were visible when the contact was broken by hand, so as to give a single flash, which seems to show they do not depend on the succession of discharges. At $0^{i}\cdot10$ the bands were curved and broad, and the stream trumpet-shaped; the negative ball had its three envelopes, and round them a wide, faint, blue haze. At $0^{i}\cdot05$, the lowest which the pump could then give, the light was faint and wide, but still blue; and each of the menisci, which are now fully developed, was, with its interval, about $0^{i}\cdot25$ across. This vacuum conducted so well, that, though the negative ball was connected with the pump plate by copper $0^{i}\cdot2$ by $0^{i}\cdot15$ section, a sheet of light passed round the sulphuric acid holder, and covered the plate with green sparks.

"The total absence of fluorescence here is very striking, and I rather hastily concluded, that this property depends on the presence of free oxygen in the vacuum.

"5. Oxygen, procured from chlorate of potassa and peroxide of manganese, and passed through solution of potassa, was next tried; gauge at $0^{i}\cdot08$. The appearance differed little from common air; the light was equally fluorescent, and the only difference noticed was, that the green sparks at the negative ball were more numerous and intense. After a while the light became greenish and the fluorescence less, then it got a peculiar copper colour, which soon passed off, and it became as at first, except that the dark bands became much more distinct.. Was this owing to the formation of ozone? On increasing the distance from 3^{i} to $4^{i}\cdot75$, the bands were scarcely visible in the middle, but reappeared towards the negative ball.

"6. I tried nitrogen prepared by leaving for four days in a confined portion of air a paste of equal parts of sulphur and

iron filings moistened with water. On this occasion chloride of calcium was used to dry the vacuum, but did not act as well as the sulphuric acid, for the gauge could not be got below $0^{i}{\cdot}25$. The light was faint till the Leyden jar was connected, when it appeared as a violet spark, surrounded by a yellow atmosphere. The envelope of the negative ball was yellowish, not blue, and no bands were noticed; but the fluorescence was strong. As both watery vapour and hydrogen were probably present, I repeated this experiment, obtaining the gas by a process for which I am indebted to Dr. Lyon Playfair, decomposing water of ammonia by bleaching powder. The ammonia must be diluted, the Wolfe's bottle in which the decomposition takes place kept cool, and the gas well washed. The extrication of it, though very rapid, is manageable, and it seems to be quite pure. From the nature of the manipulation in filling the receiver, I am sure that it could not have contained more than $\frac{1}{300}$ of common air. The discharge began to pass at $0^{i}{\cdot}30$, a brilliant reddish violet; the light on the positive ball more pink than in air; that on the negative one, indigo; the bands obscure, but the fluorescence intense. On continuing the exhaustion to $0^{i}{\cdot}04$, the colour of the stream became a tawny brown, and much fainter, the menisci became distinct, and the fluorescence continued strong.

"7. Carbonic oxide was procured by heating crystals of oxalic acid with eight times their weight of sulphuric acid. As some of the carbonic acid might pass the potassa solution from the rapid way in which the extrication takes place, a vessel containing that solution was placed in the sulphuric acid vessel to complete the absorption. At $0^{i}{\cdot}15$ the stream is beautiful; bright green, yellowish at the positive end, bluish at the other. The latter has still the two envelopes separated by a dark interval, and green combustion sparks on it. The stream is not broad, but shows the menisci in all its length very plainly. At $0^{i}{\cdot}12$ the negative envelopes became blue

and red, the light much broader and fainter; the menisci were seen only in its central part, and disappeared for 1ⁱ·5 of its middle; the fluorescence scarcely sensible.

"8. With carbonic acid, gauge 0ⁱ·07; the positive ball was covered with orange-yellow light; from this sprung a faint lilac mass of light for 2ⁱ, in which bright menisci show occasionally. Below is 1ⁱ dark; and below this, bluish haze in which is the negative ball with its red, dark, and blue envelopes. Fluorescence extremely feeble.

"Another experiment was made, intending to obtain a perfect vacuum on Dr. Andrews' plan, by absorbing the carbonic acid. The potassa solution, however, became solid when the gauge was 0ⁱ·04. The positive ball was covered with the same yellow shade, from which issued a pear-shaped mass of livid lilac, with a brighter axis, the whole full of the menisci, but faint; it was in rapid rotation, and its point rose and fell, sometimes crossing the dark space between it and the steady spherical light surrounding the negative one. In this case also the fluorescence was scarcely sensible.

"From these facts it appears that nitrogen has, as well as oxygen, the power of producing the invisible rays which cause fluorescence. Hydrogen, and compounds of it with oxygen and carbon, seem totally to want it; carbon is probably in the same predicament, and it becomes an interesting question whether other highly electro-positive bodies resemble them. On the other hand, how will chlorine and its congeners comport themselves? I could not try other gases for fear of destroying my air-pump, but an apparatus contrived by Mr. Bergin will, I hope, enable me to extend my experiments. It is like a mercurial gasometer, in which the bell-glass has a small opening at its top; the circumference of the aperture is ground flat, so that it can be covered by a flat disc of glass, slightly greased. Through the centre of this disc passes a platinum wire. When the bell is pressed under the mercury, all air escapes, especially if it be exposed for a

while in vacuo. Then applying (still under the mercury) the disc, the bell rises by its flotation, till this is balanced by the weight of mercury which is raised in it. If, however, it be placed under a receiver, on exhaustion the bell rises about four inches, leaving a Torricellian vacuum within, through which, by bringing the sliding rod of the receiver in contact with the platinum wire, discharges can be made. A hole $0^{i}\cdot2$ diameter, and $1^{i}\cdot0$ long, is drilled in the apex of the cast-iron core, by inserting in which a miniature jar of quill-tube, filled with a known bulk of any gas, before applying the covering disc, this will escape when the bell-glass rises, and thus enable one to experiment in a vacuum of that gas at any required attenuation.

"With respect to the next in interest of these facts, the existence of the luminous menisci, I am unable to form an opinion as to whether the differences which I have mentioned arise from specific qualities of the gases, or merely from the degree of density. The decided manifestation of them in hydrogen would seem to imply the latter. If so, air at 0.06 should show the same as I have described for hydrogen at 0·85 and at 0·005, as the other at 0·07. The latter exhaustion will require a better pump than mine to try it: but in the first the hydrogen shows the phenomena far more distinct than the air, and the same thing is true of carbonic acid, notwithstanding its high specific gravity.

"My present notion of these menisci and their divisions is, that they are surfaces of interference. The fact of their being produced by a single discharge shows that they do not depend on the discontinuity of the current (unless, indeed, that single discharges may be a succession of waves); and the absence of the negative blue light seems equally to show that they do not result from zones of alternating electric condition in the medium.

"The colour is related to the nature of the medium; but the rotation of the positive portion of the light, the quiescence of the negative, and its invariable division into two

envelopes, separated by a dark interval, seem to belong to the very essence of the discharge itself."

The Rev. J. H. Todd, D.D., Secretary of the Academy, read the following letter from Dr. Jacob Grimm, H.M.R.I.A., on certain formulæ or charms supposed to be in an ancient Celtic dialect, which occur in the works of Marcellus, a physician of the age of Theodosius the Great.

"*Berlin*, 20 *juin*, 1855.

"MESSIEURS ET HONORÉS CONFRÈRES—Je pris, il y a quelques ans, la liberté d'attirer votre attention sur une mince découverte, que je venais de faire. Il s'agissait de prouver, qu'un médecin du temps de Théodose le grand, natif d'Aquitaine, avait inséré dans son ouvrage de médecine quelques formules jusqu'ici inexpliquées ou plutôt négligées, mais conçues dans un dialecte gaulois, qui parait avoir été très-voisin de l'idiome irlandais. Ces formules constitueraient donc le monument le plus ancien de votre langue et sembleraient dignes d'une étude particulière.

"Messieurs, vous êtes les juges naturels de cette question, mais vous n'avez pas cru à propos d'énoncer votre opinion sur elle, ni même de faire la moindre mention de ma conjecture dans vos proceedings. Cela m'a, je l'avoue, découragé au point de laisser tomber toute cette recherche.

"Dernièrement elle a été suscitée de nouveau. Monsieur Pictet de Genève m'ayant transmis son heureuse explication de plusieurs formules de Marcellus je me suis, de mon côté, livré à une étude réitérée de cet intéressant document de l'antiquité, et j'ai pû ajouter encore quelques éclaircissements à ceux de Pictet.

"Il est de mon devoir de vous adresser un exemplaire de cette dissertation. Je serais curieux d'apprendre, si vos anciens manuscrits offrent peut être de semblables formules (des spells, en Anglais), rédigées soit en Irlandais ou en Latin, et *propres* à jeter du jour sur celles de Marcellus.

"J'ai l'honneur de vous renouveler l'assurance de mon respect,

"JACOB GRIMM.

"*à Messieurs les Membres of the Royal Irish Academy à Dublin.*"

The Secretary stated that the letter alluded to by Dr. Jacob Grimm, as having been addressed to the Academy some years ago, had never (so far as he knew) been received. The letter just read reached the Academy soon after the last meeting of the late Session, and did not come to his hands until he found it among the papers laid aside for the consideration of the Council, on their re-assembling in November last. He had since made every inquiry for the missing letter, but could find no evidence that it had ever been received.

With respect to the main subject of Dr. Grimm's letter, the Secretary stated, that he hoped on some future occasion to lay before the Academy a more complete examination of the question than he was now prepared to do. He would only say at present, that he could not go so far as Zeuss had done, in pronouncing positively that the formulæ of Marcellus were not Celtic; but he thought it almost equally difficult to assert that they were so, because the division of them into words was necessarily arbitrary, and he could conceive that ingenious theorists might readily so divide them as to support almost any hypothesis as to the family of language to which they belong.

It must be admitted, however, that the question is a very interesting one, and the thanks of the Academy are due to Dr. Grimm for bringing the subject under the notice of Celtic scholars. It is deeply to be regretted that the apparent neglect of his former communication should have tended to discourage so eminent a scholar in a philological inquiry of such interest. It is to be hoped that when he receives the explanation of our silence, he will be encouraged to pursue his investigations with renewed energy.

The Rev. J. H. Todd, D. D., read a paper on the name said to have been given to St. Patrick, when a captive in Ireland, by his heathen masters; a name which the biographers of the saint have endeavoured to interpret, without any very satisfactory result.

It appears that the father and mother of St. Patrick had taken him and his sisters to visit their relations in Armorica. Whilst they were there, a party of British (that is, as appears from the story, North British) made an inroad upon the country, slew the parents of St. Patrick, and carried him and his sisters away with them as captives. The pirates landed in the north of Ireland, where they sold Patrick as a slave to Milcho, or Miliuc, a chieftain of Dalaradia,* by whom we are told he was named *Cothraighe*.

This name has greatly puzzled the authors of the lives of St. Patrick, who all derive it from the Irish *cethair*, which is the Latin *quatuor;* and to explain it on the assumption of this etymology, they tell us that Miliuc was one of four, who had jointly purchased St. Patrick, and that the name was given him because he had become the servant of *four* masters. Thus Fiech, Bishop of Sletty, in the ancient metrical life of St. Patrick which stands first in Colgan's collection, says,—

"Batar ile Coṫraiġe
Ceaṫar trebe dia fognad."

Which Colgan translates thus:—

"Ideo vocatus Cothraighe, quia quatuor familiis inserviebat."

It will be observed, however, that this etymology does not explain the occurrence of the *g* in the name *Cothraighe*: for there is no *g* in *ceathair*, or *quatuor*.

This difficulty seems to have been felt by the author of the prose Life, (given by Colgan as his *Vita secunda*)—who latinizes the name *Quadriga;* and explains it thus: "Ipse in regione Dalaradiæ devectus, a quatuor emptus est; ex

* Vit. Trip. I., c. 16., Jocel. c. 18.

quibus unus Miliuc erat; ubi fideliter servivit. Illic *Quadrigæ* nomen accepit, quia equorum quatuor domibus servivit." —cap. 12.

It appears from Colgan's note on this passage, that some of the MSS. he used read *Quotirche*, and *Cotirche*, which he explains as a compound of *ceathair*, four, and *tigh*, a house, telling us that the true latinized form of the name is *Quadritigius*, not *Quadriga*, which he pronounces to be corrupt; and this may have been also the meaning of the author of the Tripartite Life, when he tells us that *Cothraige* means four *families*.

It is evident, however, that the author of the second life supposed the name to have contained an element which signified *horses*, for he says "nomen accepit, quia *equorum* quatuor domibus servivit." It is probable, therefore, that this ancient writer explained the *g*, by supposing the name *Cothraighe* to be a compound of *ceathair*, four, and *each*, a horse; and for "equorum quatuor *domibus*," perhaps, we ought to read, "equorum quatuor dominis."*

Colgan's explanation is wholly inadmissible; for it introduces a *t* which does not occur in the original form of the name as given by St. Fiech. To justify Colgan's etymology the name ought to be *Cothratighe*, not *Cothraighe*.

The other lives throw no additional light on the subject, although all agree in deriving the name from *ceathair*, four,

* The third Life says (c. 13), "Tunc datum est ei illud nomen, quod dicitur *Coithrige;* eo quod quatuor Dominis serviebat." The fourth Life, attributed by Colgan to St. Eleran, has the same story, but makes the four to be *brothers:* "Ductus ergo in Hiberniam, in septentrionali plagâ, venditus quatuor fratribus . . . . . . quapropter eum *Quadrigam* appellarunt."—(c. 15.) And the Tripartite Life gives the story thus:—"Erant autem et alii tres, qui cum Milchone societatis commercio Patricium coëmerunt et hinc debuit quatuor inservire dominis: unde Cothraige, quod quatuor familias denotat, appellatus est, quia quatuor familiis debebat inservire."—(Part i. c. 17.) Probus and Jocelin make no mention of the name. And it is evident that none of the biographers, except the author of the second Life, make any attempt to explain the *g*.

and explain this derivation by supposing Patrick to have been purchased by four masters—a fact which has probably no foundation except this conjectural etymology.

The derivation from *ceathair*, therefore, is evidently unsatisfactory, as leaving unexplained an essential element of the word; and the meaning of the name said to have been given to St. Patrick by his Irish masters is still open to inquiry.

Dr. Todd, therefore, was desirous of offering a conjectural explanation of the difficulty to the consideration of those members of the Academy who are interested in philological studies. He was disposed to think that the name *Cothraighe* was nothing more than a Gaelic corruption of the Latin name *Patricius*. This opinion he supported by the consideration that the Irish or Gaelic dialect of the Celtic has no native words beginning with *p;* a remark made long ago by Edw. Llwyd (Comparative Etymology, p. 20); and that words, which in Latin or in Welsh begin with *p*, are in Irish, almost without exception, written with *c*. This law being admitted, it follows at once that *Patric* would, by an Irish Celt, be corrupted into *Catric*, and that by aspirating or softening the *t* and final *c*, according to another well-known law of the language, would become *Cathrighe*, or *Cothraighe*, the exact name as given by St. Fiech, who is the most ancient authority for it, and who flourished in the latter part of the sixth century.

In confirmation of the assertion that the use of *c* in words where other dialects had *p*, was a law of the Irish language, Dr. Todd adduced the following instances:—

WELSH.		IRISH.
Pa, pe, pia.	What (quis, quæ, quod).	*Cia, ce, cid.*
Petuar.	Four (quatuor).	*Ceathar.*
Pymp.	Five (quinque).	*Cuig.*
Penn.	A head.	*Cenn*, or *Ceann.*
Plant.	Offspring, children.	*Cland*, or *Clann.*
Pren.	A tree.	*Crann.*
Mab.	A son.	*Mac.*

WELSH.		IRISH.
Prenu.	To buy, purchase.	*Cren*, or *Crean.*
Paup.	Any, every one.	*Cach.*
Pask.	*Pascha*, Easter.	*Casg.*
Pair.	A cauldron.	*Coire.*
Pryv.	A worm.	*Crumh.*
Prydd.	Clay.	*Criath.*

And so also *Pentecost*, or Whitsuntide, is in the Irish dialect, *Cincis*, (in Cornish, *pencos*), where it will be observed that the initial *p* is made *c*, whilst the *c* of the syllable *cost* remains. It is remarkable that the tendency to change the *p* sound into *k* or hard *c* exists also in the Ionic dialect of Greek; thus πῶς is *Ionice* κῶς; ποσος, *Ion.* κοσος.

It is true that we find the name of Patrick written with a *P* in very ancient Irish authorities. But this does not in any way contradict the conjecture now thrown out that his Dalaradian masters may have corrupted *P* into *C*. The fact that *p* and *c* are interchanged in the Welsh and Irish dialects of the Celtic, is undeniable. The fact that Patrick was called Cotrick by Miluic is recorded by the highest historical authority. Therefore it seems very easy and natural to infer that this change is only another example of an undoubted law of the language. The same people who changed the foreign word *Pasch* into *Cask* or *Casg*, may, without difficulty, be supposed to have changed the foreign word *Patrick*, into *Catrick* or *Cotrick*. The fact that *p* is sometimes a corruption of *c*, or, in other words, that the *c* or *k* sound is frequently in the original or primitive form of a word, and *p*, in the derived or corrupted form, is nothing to the purpose,—because there are other and as numerous instances in which the *p* is primitive. Thus, the Irish *cuig*, five, and *ceathair*, four, compared with the Latin, *quinque*, *quatuor*, seem more primitive than the Welsh *pymp*, *petuar*: and the Greek πέντε is, also, most probably, a less primitive form than *quinque*, as τέσσαρες is less primitive than *quatuor*. But, on the other hand, the Irish

Casg, Easter, is a manifest corruption of *Pascha*, as *Cincis* Whitsuntide, is of *Pentecost*,—and these are examples of foreign names in which the *p* is made *c*, in exact analogy with the conjecture, which Dr. Todd submitted to the judgment of the Academy, that *Cothraighe* was no more than a Celtic form of the Latin name *Patricius*.

Dr. Todd remarked further, that this conjecture, if admitted to be true, would supply a very remarkable confirmation of the substantial truth of the traditions incorporated into the lives of St. Patrick, and ought to render us very cautious how we reject the historical facts recorded in those lives, without very strong grounds. The fact that Patrick was called Catrick by his heathen masters, seemed a difficulty even to Fiech and the other ancient biographers of the saint. To meet the difficulty they were driven to fanciful derivations, and the circumstance of his having been purchased by *four* masters was invented to justify that derivation. But now, the comparative philology of the Celtic dialects enables us to explain a word which to the most ancient writers whose works have been preserved to us, seemed inexplicable. It is beyond a doubt that the name of *Cothraighe* did exist, and was given to St. Patrick—and it is infinitely more probable that the story of his four masters was invented to explain the name of *Cothraighe*, than that the name of *Cothraighe* was invented to explain the story of his having had four masters.

In conclusion, Dr. Todd stated that there was considerable difficulty in the translation of the passage already quoted from the Hymn of St. Fiech, which is the most ancient authority for this name. All the old biographers understand it as asserting that Patrick was called Cothraige because he was slave to four masters: and Colgan translates it accordingly. The difficulty is, that bocop is the third person plural, and that ıle appears to be the well-known word which signifies *many*, so that the meaning would seem to be,—

"There were many Cothragians
With four tribes of whom he was in slavery."

And Dr. O'Donovan, who suggests this version, states that there is a barony called Cathraighe, now Carey, in the district where Milcho resided. Dr. O'Conor takes ıle for aıle, and translates (but how the translation is to be justified does not appear), "Fuit ei nomen adoptivum *aliud* Cothrag." Dr. Heinrich Leo, in his commentary and translation of the Hymn of St. Fiech, has proposed an entirely new translation of the passage. He would render the words bacap ıle cochpaıȝe, "Magni erant greges." And he remarks "Locus hic intellectu facillimus ab interpretibus maxime difficilis redditus. Opinabantur enim, quia vocem *Cothraighe* insolito more scriptam videbant, et *quia in sequentibus narratur Patricium quatuor prædiorum pecora pavisse*, *Cothraige* esse novum nomen S. Patricio ab Hibernis inditum, *quatuor familiorum servum significans.*" But it is beyond all doubt that the story of Patrick being slave to four masters was founded on the explanation given of the name *Cothraighe*, not the name *Cothraighe* on the story, as Dr. Leo supposes. He assumes also that *Cothraighe* was an *unusual mode* of writing ceaṫpaıȝe, or caopaıȝe, cattle or sheep.* A very unusual mode indeed—for the *small* sounding diphthongs ea, or ao, never could be represented by o or a. And this is also a difficulty in the common derivation from *Ceathair*, four, for in all the authorites the name is written with the broad vowel *a* or *o*, *Cothraighe*, *Cotirche*, *Quadriga*, &c.

It is, however, doubtless a great objection to all these interpretations, that the ancient biographers of St. Patrick unanimously understand the Hymn of St. Fiech as having asserted that Cothraighe was a name given to St. Patrick by

* Zeuss translates the words *batar ıle cathraige*, "fuerunt multæ civitates," taking *cathraige* as the plural of *cathair*, a city.—*Gram. Celt.* p. 943.

his heathen masters; and their authority is supported by another of no less weight.* The ancient gloss on this passage in the Book of Hymns is as follows:—

".ı. ꞃo lenaꞅꞇaꞃ ınꞇaınm aꞃ coꞇhꞃaıᵹe .ı. ceꞇhaꞃaıᵹe .ı. aꞃınnı ꝺo ᵹnıꞇh ꞇꞃıbıbuꞅ .ıııı."

"i. e. the name Cothraighe followed him: i. e. quasi Cetharaighe, i. e. because he served four tribes."

Here it will be seen that this very ancient authority agrees with the lives, in considering Cothraighe a name given to Patrick; and paraphrases baꞇaꞃ ıle Coꞇhꞃaıᵹe, "the name of Cothraighe followed him." But how this explanation is justified by the Irish, Dr. Todd professed himself unable to explain. He could only conjecture that, possibly, the words ought to be divided thus:—

baꝺ aꞃıle Coꞇhꞃaıᵹe;
"Fuit aliud (nomen) Cothraighe;"

baꝺ being the old form, which is now bıꝺ, the third pers. sing. pret. of the substantive verb, and aꞃıle for aꞃoıle another. But the whole question being one of great uncertainty and difficulty, Dr. Todd wished to be understood as merely throwing out these suggestions for the consideration of Irish scholars.

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* The same interpretation of the name is also given in the Preface to the Hymn of St. Sechnall, *Audite omnes*, as transcribed into the *Leabhar Breac* (see the *Liber Hymnorum*, edited by Dr. Todd for the Irish Archæological and Celtic Society, p. 27). This is an authority which may not be of much greater antiquity than the thirteenth century: and is therefore not superior to that of the Lives.

JANUARY 28TH, 1856.

HUMPHREY LLOYD, D. D., in the Chair.

PROFESSOR HENNESSY read a paper on Meteorology.

"In the first part of the paper the principles and methods of meteorological inquiries were discussed, and some fundamental changes suggested. The system of fixed and pre-arranged observations was maintained not to be generally suitable to the inquiring into phenomena so singularly variable as those of the atmosphere. These views were supported by arguments drawn from considering the nature of other sciences which have for their subject matter the investigation of rapidly changing phenomena, as well as by reference to the comparative absence of any important results deduced from the pre-ordained system of observations for the true science of meteorology. The nearly similar views put forward by MM. Biot and Regnault at some of the recent meetings of the French Academy of Sciences were also occasionally referred to.

"While thus pointing out the comparative barrenness in general meteorological results of the system of inquiry so generally adopted, Mr. Hennessy fully acknowledged the value of the facts which have been acquired for the science of Climatology; and how by advancing that science they may even indirectly contribute to our knowledge of the laws of meteorology. The second part of Mr. Hennessy's paper was occupied with a theory of insular climate and its application to Ireland. It was shown that in general the isothermal lines in an island surrounded by an ocean of a higher temperature than the air over the land would have some relation to the coast line, and might even in many instances be irregular closed curves. The influence of the differences of latitude of the parts of the island on these curves would be to transport their centres towards

whatever pole of the earth belonged to the hemisphere in which the island was situated.

"In applying this theory to Ireland, Mr. Hennessy first described the physical structure of the country, especially the relations of the mountain groups to the coast line. He then pointed out how the position of Ireland was precisely such as to make it an instance for the application of his views, and quoted the result obtained by Dr. Lloyd* as to the difference of nearly 4° Fahr. in the temperature of the surrounding seas and that of the air over the land. It was then shown that the isothermal lines for the year 1851, so far as the observations contained in Dr. Lloyd's Memoir permit of their formation, would strictly conform to the theoretical views put forward.

"The paper concluded with some remarks on the application of these views to medical climatology, and the modifications they should undergo in being applied to islands situated within the tropics."

Dr. Lloyd made some remarks on Mr. Hennessy's paper.

The Secretary presented:—

1. On the part of the Dean of Waterford, a remarkable specimen of early oak carving, found in a crypt under the Deanery House at Waterford.

2. On the part of Mr. Henry O'Neill, two copies of an engraving made by himself, of an ancient gold fibula found near Coleraine, and now in the possession of Mr. Henry Gilmour.

3. On the part of Lord Dungannon, fragments of three cinerary urns found on his estate in the county Down, and quite close to the Giant's Ring.

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* Trans. R. I. A., vol. xxii.

February 11th, 1856.

SIR ROBERT KANE, Vice-President, in the Chair.

Samuel Downing, Esq., and James West, Esq., High Sheriff of the City of Dublin, were elected Members of the Academy.

Mr. Hennessy described an optical phenomenon which he observed on the 3rd of last July in the Atlantic, while on a voyage to Havre. It was a coloured glory, such as has been already minutely described by other observers, especially Scoresby and Saussure, but this instance was particularly remarkable from the conditions that accompanied it, and which pointed in a decisive manner to the true theoretical explanation of such phenomena. The day when this glory was observed was remarkably sultry, and the sea, which was perfectly smooth, was covered with scattered patches of fog. At 4½ P.M. Mr. Hennessy's attention was directed to a bank of fog close to the vessel, and in the direction exactly opposite to the sun. Three rings, sensibly concentric, were distinctly visible in the fog bank: the first or outermost was nearly pure white; the second presented faint traces of prismatic colours; and the third, which had a diameter considerably less than the others, showed a series of brilliant colours, namely, violet, red, yellow, green, and blue. As usual, the centre of this ring contained a very distinct shadow of the observer's head. The production of these rings could not be ascribed as the influence of minute icy crystals floating in the fog, as has been frequently supposed, but must be attributed to the optical action of the vesicles of vapour, for the temperature of the air over the sea, upon which the fog bank rested, was that of a warm summer afternoon, and very considerably above the freezing point.

By permission of the Chairman, Mr. Hennessy explained some results at which he had arrived since the last meeting of the Academy, relative to the influence of latitude on the positions of the isothermal lines at the surface of the earth. Setting out from the general laws of radiant heat, he had arrived at a mathematical expression for the quantity of solar heat received at a limited area of the earth's surface, which depends on an elliptic function whose modulus is the sine of the inclination of the equator to the ecliptic. From this he was able to deduce the theorem already announced as to the transportation of the closed isothermal lines of an island towards the pole, by introducing the influence of latitude. It follows also, that the isothermal lines will be crowded more closely together towards the poles. He has found that the parallel of either hemisphere, which receives the greatest amount of heat from direct solar radiation, while the sun is at the same side of the equator, has a latitude of 7° 24′.

Rev. Dr. Graves read a paper on the extension of Taylor's theorem to non-commutative symbols.

The Secretary read extracts of a letter from Mr. James Gilmour, of Coleraine, explaining the exact locality where the ancient gold fibula, called the Dalraida brooch in the Ulster Journal of Archæology, No. 13, was found. He also stated that Dr. Aquilla Smith had ascertained its specific gravity to be 15·45, and not 16·248. By permission of Mr. Gilmour, the brooch was exhibited.

Dr. Petrie made some remarks on the ornamentation of the brooch, and explained that it was chiefly interesting as being made of gold, and gave it as his opinion that it could not be earlier than the end of the eleventh or beginning of the twelfth century.

The thanks of the Academy were given to Mr. Gilmour for his kindness in lending the brooch for exhibition to the Academy.

Dr. Corrigan made a short communication on the action of the wind in different directions producing waves on the surface of water in a glass vivarium, with the view of exhibiting a class of phenomena on a very small scale, which in nature he thought might in some degree explain the effects of the wind on lakes bounded more or less by mountains.

Dr. Neligan and Mr. Hennessy made some remarks.

MONDAY, FEBRUARY 25TH, 1856.

THOMAS ROMNEY ROBINSON, D.D., PRESIDENT, in the Chair.

ON the recommendation of the Council, it was

RESOLVED,—That the additional annual Grant of £200 given by Parliament be devoted—£100 per annum to the purchase of Books for the Library; and £100 per annum for the purchase of Antiquities for the Museum.

It was also—

RESOLVED,—That it is the opinion of the Academy, that in case the sums appropriated to these several purposes be not expended within one year, the balance should be carried over to the credit of the Library and Museum respectively.

Mr. Huband Smith read a paper on the history of the Castle and Manor of Baggotrath, and exhibited a drawing from a sketch made by Gabriel Beranger, about the year 1760; also a curious plan of the array of the Parliamentary forces of the garrison of Dublin, as drawn out before the battle which took place in 1649, in which the royal army, under the command of the Marquis of Ormonde, sustained a remarkable defeat, the disastrous effects of which ended in the total ruin of the royal cause in Ireland. This curious plan, which is without name or date, is preserved in a valuable collection of ancient maps and drawings, in the MS. room of the Library of Trinity College, and is noticed, among others, in a paper read before the Academy by the late James Hardiman, in 1824. From this plan it would appear that a sort of entrenchment extended round a considerable extent of land, comprehending within its limits St. Stephen's-green, and probably Merrion-square, Fitzwilliam-square, and the site of the adjoining streets.

The names written on the roads or ways, at the extreme points of this plan, are as follows:—"Colledge green waye, St. Stevan's street waye, St. Kevan's street waye, Dunnabroke waye, and Baggotrough waye."

He also exhibited an enlarged copy of a portion of Rocque's map, or "Survey of the City and Suburbs of Dublin," published in 1757, on which is laid down the line of road from Stephen's-green to Ball's-bridge, over the river Dodder, now Lower and Upper Baggot-street; on the north side of which is shown on this map the site of Baggotrath Castle.

The original structure was originally built some time in the twelfth century, as appears from various notices of it in the public records; and Mr. Smith read several extracts from the Memoranda Rolls of the Court of Exchequer and Patent and Close Rolls, illustrative of the history of its possessors, at different subsequent periods. The latest structure, the ruins of which were standing within the memory of many persons now living, was a massive square tower, built, as there can be little doubt, from the drawings exhibited, about the time of James the First or Elizabeth. It was taken down upon the occasion of the building of the houses along the north side of Upper Baggot-street, and a house, which is higher by one story than the adjoining ones, marks the exact position which the Castle of Baggotrath occupied.

The following are a few of the most curious extracts read by Mr. Smith:—

In the Charter Book, sometimes called the "Domesday Book," of the Corporation of Dublin, are preserved two curious charters, the first from John de la Warre, Mayor of the city of Dublin, to Maurice Fitzgerald, in which the boundaries of the manor of Rath are fully set out. From the second, it appears that the manor of the Rath, with its appurtenances as therein described, was held by Philip de Hynteberg, and afterwards by his grandson Nicholas, who sold it to Lord Robert

Baggot, as fully as he or his grandfather held it, reserving, however, a yearly chief rent of 20 marks thereout to the citizens of Dublin.

In the year 1320, the same Robert Baggot, being sued for the aforesaid Rath, pleaded his title under the Corporation, stating that he held same of the Mayor and citizens of Dublin, and that it was within the bounds of the city.

In the year 1322, the lands of Donnybrook, which belonged to the Manor of Baggotrath, were conveyed, by the above named Robert Baggot, to Fromund le Bruyn, who reconveyed them to Thomas, the son of the same Robert Baggot.

A.D. 1442. James Cornewalsh, the Chief Baron of the Exchequer, came from his residence, at Dunboyne, on the 28th of September, 1442, for the purpose of taking his seat in that Court, or, as the record informs us, "Causa sedendi in scaccario domini Regis, ibidemque Deo favente justiciam faciendum in crastino sancti Michaelis tunc proximo sequente;" and that he came to his Manor of Baggotrath, situate within the liberty of the city of Dublin, where, as the same record states, "more solito sub quiete et pacis domini Regis supradicti tranquillitatem una cum suis tantum domesticis dicto vicesimo octavo die residebat." While he was there, however, William Fitz William, of Dundrum, Esquire, "cum magna multitudine hominum armatorum modo guerrino," entered the hall of the Manor in Baggotrath, "cum gladiis, arcubus, lanceis, et fustibus," and there, "proditorie et felonicé," and against the king's peace, "ut vulgariter et notorie dicitur," he most wickedly slew him. [Memoranda Roll of the Exchequer, anno 21 Hen. VI.]

A.D. 1480. The Corporation of Dublin presented a petition to a Parliament held before Gerald Earl of Kildare, the deputy of Richard Duke of York, stating that, by the death of Richard Fitz William, "franque home et demeurant deins la franchise del dit citie, le quele fuist seizie del seigneurie de

Bagotrath," his son and heir, being a minor, and that the king had claimed the wardship of Baggotrath, which was within the franchises, and held of the Corporation by the service of 20 marks yearly, whereby they would be deprived of their distress for the said sum, and they pray a remedy; which is granted them, upon the condition that they shall take but £10 during the nonage of the heir, and apply the remaining five marks upon the repair, "del chiefe lieu."

By an inquisition taken at Dublin Castle, anno 20 Hen. VIII., A. D. 1529, it was found that Ellinor Dowdall, the widow of Thomas Fitz William, of Baggotrath, Esquire, deceased, was seized of one-third of his estates. It also finds that his son and heir, Richard Fitz William, made his will, which is set forth, *in hæc verba*, upon the record, and bears date the 12th day of July, anno 15 Hen. VIII., whereby he directs "his body to be burit at the Whit frirs of Dublin," to whom he bequeaths "a gown of sattyng, and a dowblett of [ ], to make them westments." He leaves "to the church of Myrryon a gown of chamlett and a doublett of sattine to make westments." He leaves his "ffynest blak hose to Morish, my gostly father." He adds, "Item, I will that my wiff shall sitt and dwell in the place of Bagotrath as long as hit shall pleas her [ ] as my heyr be able to entyr in hit." The Inquisition further finds that Richard died on the 30th of August, 20 Hen. VIII., leaving Thomas Fitz William, his son and heir, aged seven years, and unmarried, and that Baggotrath was held by the Mayor and bailiffs of Dublin, by the service of 20 marks yearly rent. [Exchequer Inquisition.]

The last remarkable event in connexion with the history of this Castle was the attempt made by the great Duke of Ormonde, when in command of the Royal army of Charles the First, to fortify Baggotrath Castle, which resulted in the battle of Rathmines, fought on the 2nd of August, 1649,

the details of which are given in the memoirs of Edmund Ludlow, who held a high command in the Republican army, and also, at still greater length, by Carte, in his Memoirs of the Duke of Ormonde.

In Richard Burton's account of "The Battles, Sieges, and other considerable Transactions, both Civil and Military, during the late War in Ireland, till the entire reduction of that Country," written in the time of William the Third, the attempt of the Duke of Ormonde to take Dublin from the garrison of the Commonwealth, in which he so signally failed, is more briefly narrated.

Having "made agreement with the Lord Inchiquin and his forces, and likewise with those of the Marquis of Clanricard, and the Earl of Castlehaven," who were "all joined under his command," he came before Dublin with all his army, and obliged Colonel Jones, the Governor, who had drawn out some of the garrison to interrupt them, to retire into the city, which was indifferently fortified, and plentifully manned both with horse and foot. The Duke of Ormonde, wanting money and provisions, and his troops, which were composed partly of English as well as of Irish soldiers, murmuring against each other, he was almost resolved to have marched away, but changed his intention on learning that Drogheda was surrendered, together with Dundalk, the garrison compelling Colonel Monk to deliver it, and the soldiers having taken up arms for the King. The garrison of Trim also was soon after taken from the Parliament; after which the Lord Inchiquin brought up his forces, now much increased, to assist the Duke of Ormonde at the siege of Dublin. His design was to shut up the garrison, then commanded by Colonel Michael Jones, within their works, and hinder the cavalry, which formed a large proportion of the Republican forces, from getting forage, or grazing for cattle without the line which was drawn round the town.

Carte, after relating the taking of the Castle of Rathfarnham by storm by the Royal troops,—the assailants showing so much mercy, that, though 500 common men got in before any officer of note entered the place, not one of the besieged was put to the sword,—proceeds to state, that the troops of the Parliament having no place to graze in but the pasturage on the south side, near the walls—there being no grass within the town, and no means of grazing on the north side, by reason of the army under Lord Dillon, there posted,—it was proposed to possess and fortify the Castle of Baggotrath, very near adjoining that meadow; which, if effected, would have deprived them of the only pasture they had, and would have starved all their horse in five days. Orders were thereupon given to Major-General Purcell to summon thither, in the night, 1500 foot, with materials to fortify it; who accordingly began, as soon as it was dark, to march with that party; but met with so ill guides, that though it was within half a mile of the leaguer, he did not get thither a full hour before day.

Ludlow's narrative informs us, that Baggotrath had a rampart of earth about it, and that the Royal troops had wrought upon this to augment its strength a whole night before they were discovered. But the next morning, Colonel Jones perceiving their design, concluded it absolutely necessary to endeavour to remove them from thence before their works were finished. To that end he drew all his forces, both foot and horse, to the works that faced the enemy, and, leaving as many as he thought necessary for the defence of the town, he sallied out with the rest, being between four and five thousand, and, falling upon them, beat them from their works, killing Sir William Vaughan, who commanded them, and most of the men that were with him, and closely pursuing the rest, who fled towards the main army, which was stationed near Rathmines. In this engagement, Burton relates, that of the Royal army 4000 men were killed, and 2517 made prisoners, having among them many

persons of quality, and all their cannon were taken, and a rich camp to reward the soldiers. The chief resistance offered appears to have been from a party of Lord Inchiquin's horse, that had formerly served the Parliament, who defended a pass for some time, but were, after some dispute, broken, and forced to fly. Having routed these, Colonel Jones marched with all diligence up to the walls of Rathmines, which contained about ten acres of ground, where many of the enemy's foot had shut up themselves; but perceiving their army to be entirely routed, and their general fled, they yielded themselves prisoners. The result of this engagement seems to have been wholly unexpected on both sides, the troops of the Parliament having been led, step by step, to an absolute victory, whereas their utmost design, at the beginning of the action, was only to beat the enemy from Baggotrath, and was so surprising to the Royal forces, that they had not time to carry off their money, which lay at Rathfarnham, for the paying of their army, where Colonel Jones seized £4000, very seasonably for the payment of his troops.

This signal defeat of the Royalist army, which was so disastrous in its results, appears to have been the last remarkable historical event with which the Castle of Baggotrath was connected. It was never afterwards repaired, but suffered gradually to moulder into ruin. The office of Governor of this Castle is stated to have been, although a mere sinecure, filled up from time to time, and a salary paid, down to the period of the Union, when, with other appointments of a similar nature, it was abolished, compensation having been made to the last Governor, Sir John De Blaquiere.

Mr. Smith, in conclusion, intimated his intention of following up the investigation of historical events relating to the Castles of Rathmines, Rathgar, and Rathfarnham, whose names alone afford evidence of the antiquity of the sites on which they are built, and with regard to which many most

interesting particulars remain on record, which have never yet been collected together.

Mr. O'Flanagan made some remarks on Mr. Smith's paper.

Dr. Petrie stated that he recollected the Castle and the demolition of the Rath, in which some stone celts were found, which are now in his museum.

John Neville, Esq., C.E., read a paper on a new experimental Hydraulic Formula for finding the velocity of water in water-channels.

Sir W. R. Hamilton, LL. D., read a paper on a geometrical extension of the Calculus of Quaternions, as concerns its fundamental interpretations.

A fac-simile of the box of St. Molash, made by the electrotype process, was presented by James West, Esq., M. R. I. A.

Portion of a wooden spindle, and a bone and bronze pin, found at Confree Lake, near Strokestown, were presented by Rev. Porter Browne, of Ahascragh.

The Secretary exhibited, by permission of Sir Erasmus Borrowes, Bart., a stone stamp, found in the Crimea, containing impressions of religious monograms.

Saturday, March 15th, 1856.

THOMAS ROMNEY ROBINSON, D.D., President, in the Chair.

The Secretary of the Council read the following Report from the Council:—

REPORT.

The history of the Academy for the past year does not present much which calls for particular remark from the Council.

The printing of the Transactions and Proceedings has been carried on with much regularity.

Of the Transactions, the twenty-second Volume has been completed, the sixth Part having been published in March last. Considerable progress has been made in the printing of the first and second Parts of the twenty-third Volume, and several papers passed by the Council for publication are in the printer's hands.

The Proceedings of the Academy will show that many interesting papers have been communicated to us during the past year.

In Pure Mathematics, we have had papers from Sir William R. Hamilton, Rev. Dr. Graves, Rev. Mr. Salmon, and Rev. Mr. Carmichael.

In Mixed Mathematics, from Mr. Forster, Mr. Mallet, and Mr. Hennessy.

In the Sciences of Observation and Experiment, papers have been given us by the President, Rev. Dr. Harvey, Rev. Mr. Galbraith, Rev. Mr. Haughton, Dr. Aldridge, Mr. Barton, Mr. Hennessy, and Mr. Neville.

In Polite Literature, we have had papers from Dr. Waller, Rev. Dr. Hincks, Rev. Dr. Nolan, and Rev. Dr. Graves.

In Antiquities, from Dr. Petrie, Rev. Dr. Todd, and Mr. Smith.

Some time since, the Council had the pleasure of announcing to the Academy, that, in compliance with a request addressed by the President to the Lord Lieutenant, the annual Parliamentary Grant

had been increased to £500. The addition thus made to our funds has been allocated by the Academy to the Library and Museum; and the efficiency of both these departments will thus be greatly increased.

The Council regret that there has been much delay in the arrangement and cataloguing of the articles in the Museum. The cases intended for their reception are not yet complete; but as soon as this deficiency, which has retarded the process of arrangement, shall have been supplied, they hope to be able to proceed more regularly and speedily with this important work.

A most important addition has been made to our Library within the last year. By the liberality of Mrs. Moore, the fine Library of the late Thomas Moore has been placed at our disposal, and, in compliance with her wish, a separate apartment has been devoted to the reception of the books, which will thus remain with us as a lasting memorial of one whose name holds so high a place among the records of Irish genius. It is needless to say, that the marked thanks of the Academy have been presented to Mrs. Moore for this splendid gift.

It will be seen by the balloting list that the number of vacancies upon the Council on the present occasion is unusually large. The simultaneous removal of so many Members, whose experience had rendered them practically acquainted with the business of the Academy, is much to be regretted. It seems desirable that in such a case some restriction should be placed upon the working of the rotation rule. This point will probably engage the attention of the new Council.

It is, perhaps, unnecessary to remind the Academy that, in accordance with a Resolution, passed in February, 1846, our President retires from office to-night; it will, therefore, be the duty of the Academy, should they approve of the recommendation embodied in that Resolution, to elect another person to fill the office of President.

A considerable addition has been made to the Museum during the past year by the purchase of—

1. A large collection of Antiquities, formed by Mr. William Wakeman.

2. A Silver Abbey Seal, purchased through the Rev. Dr. Todd.

3 & 4. A highly ornamented Bronze Celt, of the hatchet-shape pattern, and unusually large; also, a very beautiful Charm, or Bulla, formed internally of lead and superficially of gold, elegantly chased, were purchased from Mr. John Donegan.

5. The Capital of a Gothic Column, highly ornamented, was bought from Mr. Clany.

6. A few articles, found near Strokestown, were purchased from Mrs. Conry.

7. A small collection of Silver Coins, said to have been found in an excavation made in the Giant's Ring, near Belfast, were purchased through John B. Barker M.D.

8. A Sword and Dagger, were bought from Mr. John Williams.

9. An ancient Casting in Bronze, representing the Crucifixion, a Gouge, Dagger, and Fibula, composed of antique bronze, from Mr. John Underwood.

During the past year we have lost, by death, one Honorary Member, namely—

ADMIRAL SIR WILLIAM EDMOND PARRY. (Died July 7, 1855.)

During the same period we have lost three ordinary Members, namely—

JAMES HARDIMAN, Esq.
RICHARD W. TOWNSEND, Esq., C.E.
GEORGE CHAMLEY, Esq.

Seven new Members have been elected since the last annual meeting—a number unusually small. Their names are—

J. T. Gilbert, Esq.	Edward Wright, LL. D.
John Ringland, M. B.	Samuel Downing, Esq.
John Edward Walsh, LL. D.	James West, Esq.
Edmund William Davy, M.B.	

IT WAS RESOLVED,—That the Report of the Council be adopted, and printed in the Proceedings.

It having been signified to the Academy that the Rev. Dr. Robinson had filled the office of President for the last five years, the Rev. Charles W. Wall, D.D. (Vice-Provost of Trinity College), proposed, and the Rev. Humphrey Lloyd, D.D., seconded, James Apjohn, M.D., as President.

Lieut.-Col. Thomas A. Larcom, R.E., proposed, and the Rev. Charles Graves, D.D., seconded, the Rev. James Henthorn Todd, D.D., as President.

The Rev. George Salmon, A.M., proposed, and the Rev. John H. Jellett, A.M., seconded, the Rev. Humphrey Lloyd, D.D., as President.

It was Resolved,—That the Scrutineers shall report at present the result of the Ballot for President only; and that the Ballot Papers for the Council be held over to an adjournment of this meeting.

It was also Resolved,—That this meeting, at its rising, do stand adjourned to Tuesday next, the 18th March, at 8 o'clock.

The Ballot having closed, the Scrutineers reported that the Rev. James Henthorn Todd, D.D., had been duly elected President of the Academy for the ensuing year.

The Rev. Thomas Romney Robinson, D.D., having left the Chair, it was occupied by the new President; whereupon it was proposed by the Rev. Humphrey Lloyd, D.D., and seconded by George Petrie, LL.D., and—

Resolved unanimously,—That the grateful acknowledgments of this Academy are due, and are hereby presented, to the Rev. Thomas Romney Robinson, for the untiring zeal which he has displayed in attending to their interests during his Presidency, and of which he has left a lasting memorial in

the house in which we meet, and in the augmented resources of the Royal Irish Academy.

The Academy then adjourned to Tuesday, March 18, at 8 o'clock, for the transaction of the remainder of the business of the Stated Meeting.

TUESDAY, MARCH 18TH, 1856. (Adjourned Stated Meeting.)

JAMES HENTHORN TODD, D.D., PRESIDENT, in the Chair.

THE Ballot for the annual election of Council and Officers having been scrutinized in the face of the Academy, the President reported that the following gentlemen had been duly elected as Members of the Council and Officers for the ensuing year:—

Committee of Science.

Robert Ball, LL. D.; Sir Robert Kane, M.D.; Rev. Humphrey Lloyd, D. D.; Rev. George Salmon, A.M.; Rev. Thomas Romney Robinson, D. D.; James Apjohn, M. D.; Robert Mallet, Esq.

Committee of Polite Literature.

Rev. William H. Drummond, D. D.; Rev. Charles Graves, D. D.; Rev. John H. Jellett, A. M.; John Francis Waller, LL. D.; Rev. George Sidney Smith, D. D.; John Kells Ingram, LL. D.; John O'Donovan, LL. D.

Committee of Antiquities.

George Petrie, LL. D.; William R. Wilde, Esq.; J. Huband Smith, Esq., A. M.; Denis Henry Kelly, Esq.; Charles Haliday, Esq.; Sir Bernard Burke (Ulster King-at-Arms); John T. Gilbert, Esq.

Treasurer.—Robert Ball, LL. D.
Secretary to the Academy.—Rev. Charles Graves, D. D.
Secretary to the Council.—Rev. J. H. Jellett, A. M.
Secretary of Foreign Correspondence.—W. R. Wilde, Esq.
Librarian.—Rev. William H. Drummond, D. D.

Clerk, Assistant Librarian, and Curator of the Museum. —Mr. Edward Clibborn.

The President nominated under his hand and seal the following Vice-Presidents:—George Petrie, LL. D.; Sir Robert Kane, M. D.; James Apjohn, M. D.; Rev. George Sidney Smith, D. D.

The consideration of the question as to the appointment of Deputies for Members of the Council was adjourned to the next meeting of the Academy.

MONDAY, APRIL 14TH, 1856.

JAMES HENTHORN TODD, D.D., PRESIDENT, in the Chair.

CHARLES COPLAND, Esq., Nicholas Smith O'Gorman, Esq., and George Johnstone Stoney, Esq., were elected Members of the Academy.

On the recommendation of the Council, the following By-Law (Chapter VII., sect. 6) was repealed:—

"In case of the sickness or absence of any Member of a Committee, to be signified to the Secretary of Council, that Member of such Committee shall nominate a Member, *pro tempore*, out of the names which have been proposed by the Council to fill the Committees, and which have not been elected; the Member's nomination shall then be signified to him by the Secretary of Council; and in case the President shall approve such nomination, such member, *pro tempore*, shall be vested with all the powers of a Member of Council."

The Treasurer presented the General Abstract of the Monthly Abstracts of Accounts for the past year, ending the 31st March last.

The President delivered an Inaugural Address.

IT WAS RESOLVED UNANIMOUSLY,—That the President be requested to allow his able and eloquent Address, just delivered, to be printed in the Proceedings.

The President's Address was as follows:—

MY LORDS AND GENTLEMEN,—It would be impossible for me, by any words, to express to you how highly I esteem the honour you have done me, in calling me by your suffrages to occupy this Chair. I am conscious that I have but little claim to be enrolled

amongst those eminent and distinguished men who have been my predecessors in this high trust,—men who have enlarged the boundaries of human knowledge, furnished us with new powers of thought, and placed in our hands new instruments with which to penetrate still further into the regions of the infinite and the unknown. To such men I am immeasurably inferior,—but the consciousness of my inferiority makes me the more deeply grateful for the unmerited distinction you have conferred. I feel that I owe to your friendship what I could not lay claim to from intellectual or scientific superiority; and it is, indeed, an honour which the noblest and highest in the land might prize, to have received from such as you a proof so distinguished of your confidence and your esteem.

But, however inferior to my illustrious predecessors in other respects, I will not admit myself to be their inferior in zeal for the welfare, or in anxiety to promote by every means within my power, the advancement and the usefulness of the Royal Irish Academy. I have long regarded this Academy as being one of the most important institutions of this country, bringing us together, as it does, men of different professions, of different tastes, of different intellectual pursuits, and uniting us in one society, held together by the common tie of promoting, each in his own department, and in accordance with his peculiar studies, the advancement of knowledge, and the extension of useful learning.

In a country circumstanced as Ireland is, torn with internal jealousies, and external sources of dissension; where there are but few rewards for scientific students, and but little encouragement to the pursuit of the higher and severer branches of solid learning,—it is not easy to overrate the importance of an institution like this Academy, which holds out at once rewards and distinctions to the successful investigator of truth;—rewards and distinctions of a nature the most grateful to literary men—and at the same time affords a common ground on which all can meet as brethren associated in the common pursuit of knowledge,—fulfilling that prophecy of the illustrious parent of modern science, "Tum enim homines vires suas nôsse incipient, cum non eadem infiniti, sed alia alii præstabunt."

With this principle the immortal Bacon seems to have been most

deeply impressed; he recurs to it continually, and repeats it in various forms in every part of his philosophical works—the principle, namely, that the greatest progress of human knowledge must be looked for from the association of men engaged in the investigation of different and seemingly unconnected branches of study, bringing together as into a common stock or storehouse, and communicating freely to each other, the results of their various labours.

It has therefore always appeared to me a proof of singular wisdom and foresight in the eminent men to whom we owe the foundation of this Academy, that they did not confine its labours to any one branch of science, but divided it into departments, to comprehend, as far as possible, the whole range of human learning. Can any one doubt that if this Academy had been in its original constitution an Academy of Science only, or a Society of Antiquaries only, it must long ago have met the fate of the older Society founded by Archbishop Marsh when he was Provost of Trinity College, in imitation of the Royal Society, or of that still older Society, over which Molyneaux presided, founded on the same model, at the close of the seventeenth century?* The number of literary men, devoted to any one pursuit in this country, was at that time too small for the efficient support of any Society standing on the basis of Science alone, or of Archæology alone, or Classical studies alone. For this reason, therefore, were there no other, it is manifest, that this Academy must long since have ceased to exist, but for the wise constitution it received from its founders, embodying the great principle of Bacon's philosophy to which I have already alluded, and associating in one common cause the cultivators of the severer sciences, with the student of languages, the classical scholar, the historian, the archæologist.

And that this favourite principle of Bacon was in the contemplation of our founders, appears the more probable from this, that the three Committees into which they divided the Academy seem to have been suggested by the threefold division of human knowledge adopted by the illustrious restorer of learning, and derived from the ancient division of the intellectual faculties of man,—Memory,

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* See Preface to vol. I. of Transactions, Royal Irish Academy.

Imagination, and Reason. To Reason we owe the knowledge of Mathematical and Physical, Psychological and Metaphysical science, or Natural Philosophy, in the widest acceptation of the term; to the Imagination belong the Belles Lettres, Poetry, and Fiction; to the Memory—History, Archæology—the knowledge of the Past.

This account of the constitution of the Academy, as intended to embrace the whole circle of human knowledge, appears to me to give a more correct idea of the objects of our studies than the division suggested by one of my most distinguished predecessors in this Chair, who, on an occasion similar to the present, classified the objects proposed to us by our founders under the categories of the True, the Beautiful, and the Old.

This classification (suggested evidently by Cousin's *Vrai*, *Beau*, *Bien*) partakes largely of the poetical elegance which is so remarkable a characteristic of my distinguished friend's mind; but nevertheless it may, I think, lead some to an erroneous conclusion, which he himself, I feel assured, would deprecate as much as I do. Therefore, it is not as objecting to what he has said that I make this remark; for I would rather call your attention to his Inaugural Address as containing much valuable matter, eloquently and beautifully expressed, which will at all times be read with interest and profit by the Members of the Academy. But I desire to guard against the inference, which he did not draw, and would have been, I know, the last to draw, that the study of the Beautiful and of the Old is not also as much the study of the True, as are those transcendental conceptions of mathematical thought,—those wonderful researches into the infinite,—which are the natural sphere of such rare minds as his, and which have established for the name of HAMILTON a world-wide and lasting fame.

Nay, there is a sense in which the speculations of the abstract mathematician are, perhaps, less entitled to the name of Truth, than the investigations of the philologist or the historian. When we speak mathematically of points, and lines, and curves; of bars inflexible, imponderable; of orbits described by planets and comets in the fields of space,—we speak of mere abstractions or conceptions of the mind, which have not, and cannot have, a true or real existence in

nature. The inferences, therefore, which we draw by reason and calculation from these conceptions are or may be true, although they often lead only to other more refined and more general conceptions, as unreal, and as much the creation of the mind, as the premises from which they have been deduced. We must, therefore, distinguish the different kinds and forms of Truth: Truth metaphysical, or abstract; and Truth material, or in fact. The naturalist, the chemist, the anatomist, the physicist, the astronomer, are in pursuit of material truth; they are investigating the laws which are found, in fact, to regulate the structure and life of animals and vegetables; the actual properties of the substances with which we have to deal, the structure of the crust of the earth; the laws of heat, of magnetism, of electricity, the magnitudes and motions and distances of the heavenly bodies,—in a word, their business is with the region of Fact, and of Truth material.

But does not the study of human languages, the investigation of ancient manners and customs, the interpretation of inscriptions, the knowledge of coins and medals; the drama, the poetry, and literature of ancient and modern nations; the examination of the relics of ancient art and domestic habits,—do not such studies also deal with fact and truth,—nay, are they not valuable or worthless, precisely in the same proportion in which their results are true or not true?

Yea, even poetry and fiction themselves, the very creatures of the imagination, must stand their trial, after all, before the tribunal of Truth? The poet, who describes a sunset or a battle, is admirable or ridiculous, in the same degree in which his description is in conformity or inconsistent with nature and probability, in other words, with Truth. The novelist, or the dramatist, must make his characters agree as nearly as possible with those who are met with in real life; and the Arabian Nights' Entertainments or the plays of Shakspeare, would never have attained their well-earned popularity but for the truthful representation of national manners and customs, the perfect delineation of human passion and character, which are their peculiar charm: nay, their very genii and fairies—those pure creations of the imagination—would not be tolerable, were they not consistent with the original conception

of such fancied beings, and so, true to the mythological fiction, which gave to those beings an existence in the phantasy of the human mind.

To pass on, however, to graver subjects,—Philology, Archæology, and that most interesting and important study which is akin to both, Ethnology, can only be rightly studied in the spirit of the same inductive reasoning, which Bacon has taught us to apply to the advancement of every branch of knowledge. The archæologist, for example, has to deal with "the remnants of history" only, 'tanquam tabula naufragii;" and it his business, as Bacon describes it, "by an exact and scrupulous diligence and observation, out of monuments, coins, words, proverbs, traditions, public and private records and evidences, fragments of stories, passages of books that concern not the story, and the like, to save and recover something from the deluge of time." "Res sane operosa" (he adds) "sed mortalibus grata, et cum reverentiâ quâdam conjuncta; ac digna certe, quæ, deletis fabulosis nationum originibus, in locum hujusmodi commentitiorum substituatur; sed tamen eo minus habens auctoritatis, quia paucorum licentiæ subjicitur quod paucis curæ est."*

In these most pithy words the great parent of modern philosophy has ably described the difficulty which has in all ages obstructed the progress of Archæology. To investigate Truth from the scattered fragments of antiquity requires an extent of learning, in every branch of human knowledge, as well as a patient spirit of sober and sound judgment, for which few are qualified. And that study, which is thus necessarily within the reach of few, presents itself to mankind as resting upon the authority of but few, and is, therefore, if I may so say, at the mercy of those few.

But the difficulty of discovering truth in this branch of science does not make Truth to be the less its real object: the facts and materials from which Truth is to be gathered are here more fragmentary and more widely scattered than in other sciences; and the key which may solve and explain the phenomena is sometimes to be found in the most improbable and unexpected places; still, Truth

* De Augm. Scient., lib. II. c. vi.

is, after all, the precious gem for which the archæologist must search, and for which he must not hesitate to grope through heaps of rubbish; and every other science, every other branch of human learning, is capable of giving him aid. Sometimes he will of necessity be compelled to have recourse to conjecture or to theory; but then, he must, in those cases, honestly confess that what he asserts is conjecture only: his theory must be put forward, not as a fixed conclusion, but as intended to direct inquiry, and to guide to a deeper and a wider search. But it is only when that wider search has confirmed his theory or his conjecture, that his conclusion can be received as a fragment of precious truth, "saved," as Bacon has expressed it, "from the deluge of time."

Will you bear with me for a moment, if I venture to illustrate this observation by an example? You all know the remarkable fact to which your Museum gives ocular demonstration,—that in Ireland we have found, and are still daily finding, an almost incredible quantity of gold ornaments. A large hoard of these, amounting in intrinsic value, so far as I can learn, to nearly £2000, was discovered last year in the cutting of a railway in the county of Clare; some of them, your liberality, and the assistance given us by Government, have enabled the Committee of Antiquities to secure for your Museum. The discovery of so large a number of these precious ornaments in one place is of course of rare occurrence. But scarcely a month passes in which some isolated articles of the same kind are not found in various parts of the country. Our goldsmiths' windows are full of them, and heaps of them are daily consigned to the crucible, because it is impossible to find the means of saving them from such a fate. It would be very important and interesting, if every goldsmith in Ireland would communicate to this Academy the intrinsic value of all the ancient gold which had passed through his hands since he had been in business. The result, I have no doubt, would astonish most people, and would give us a more definite idea of the great extent to which the use of those ornaments prevailed among some of the early inhabitants of this country. But even without this more accurate statistical return, we know enough to be assured, that the use of gold rings, and torques, and circlets, must have been a characteristic of some of the aboriginal settlers in

Ireland. Where did this gold come from? There is no evidence of any trade at so early a period between the natives of Ireland and any gold-producing clime. Geology assures us that there are no auriferous streams or veins in Ireland capable of supplying so very large a mass of gold. It follows, then, that some tribe or colony, who migrated into this country, must have carried these ornaments on their persons. Does ancient history speak of any such tribe of emigrants, remarkable for this class of ornaments? To answer this question, we are compelled to search the Greek and Latin classics: and we learn from Plutarch, from Cæsar, Livy, Tacitus, Pliny, and many other authorities, that the so-called barbarians, known as Γαλαται and Galli, were powerful warriors, whose bodies were covered with rings or armillæ, and torques, and plates of gold; that on more than one occasion the sight of such masses of the precious metal on the naked bodies of these rude invaders excited the cupidity of the Roman legions, and added vigour to the impetuosity of their charge. Now the Gauls, it is admitted, were a portion, at least, of that great stream of emigrants, one branch of which found rest in Ireland, and who are known by the name of Celts, or Kelts, as the word is now very generally and more correctly pronounced. But where did the Kelts or Gauls get their gold? This question is not so easily answered; and here there is need of further research among the obscurer sources of history. Irish tradition brings them from Egypt to Hindoostan; then by the passes of Caucasus to Scythia, to Greece, and along the coasts of the Mediterranean to Spain.* One Irish authority, a writer of the eleventh century,† fixes upon the river Pactolus as the exact site of the tribe that had the particular name of Scoti; and even though we should reject this tradition as a fiction, it shows, at least, the necessity that was then felt of bringing the aborigines of Ireland from a region known to be auriferous. But it is not by any means impossible, that

* See Keating; and the Duan Eireannach (Irish Version of Nennius, p. 221, *sq.*)

† The author of the Life of S. Cadroc, ap. Colgan, Acta Sanctorum, p. 494.

historical truth may ultimately be found enshrined in these traditions; the labours of the great philologers of Germany have already established, beyond all doubt, that affinities exist between the language of the Celt and the ancient Sanscrit of Hindoostan; and this discovery throws a ray of probability upon the curious tradition of our Irish bards, hitherto regarded as a pure fiction, that the Milesian ancestors of the Gaedhil, in a remote antiquity, had passed through India. Perhaps the science of Chemistry might be found to aid in this ethnological inquiry, by analyzing the gold of our ancient torques and fibulæ. I know not how far a knowledge of the particular alloy employed in their manufacture, would be found to lead to an estimate of their antiquity, or to a conjecture as to the country from which they came. But there is another investigation calculated to elucidate this subject, to which geographers and travellers might contribute. The sepulchral monuments peculiar to the Celtic tribes, for which some modern antiquaries have invented the name of cromlech,—the cistvaens, maenvirs or stone pillars, cairns, and mounds,—all these are found in India, but exist in the greatest number in the countries which were the ultimate resting-places of the Celtic race, Ireland, Wales, Armorica or Brittany, North Britain, and the smaller islands of the Irish and British Seas. If the positions of all these monuments along the coasts of Europe and Scandinavia, through the great continent of Asia, and so on to India, were accurately known and mapped down, we would have at once, perhaps, the course of that great migration which peopled these countries in the remote ages of which these very monuments are the only historical record that now remains to us.

To return, however, from this digression. The progress of civilized man in every branch of human knowledge, during the last seventy years, the period in which this Academy has flourished, has been most rapid and extraordinary.

I. In Science, theoretical as well as practical, I need not tell you what brilliant discoveries and important inventions immortalize the first half of the nineteenth century. It is not, perhaps, too much to say, that in that short period mankind has done more, and made more real progress, than in the thousand years that preceded it. The steam-engine and the electric telegraph alone are practical

inventions, bearing upon the material progress of the human race, which in their ultimate results (and of those results we have by no means as yet reached the limit) will bear comparison with the invention of gunpowder, and of the art of printing; whilst in Astronomy, in Chemistry, in Physical Optics, in Geology, in Pure Mathematics, in Natural History and Botany, in Medicine and Surgery, the progress has been great, and is steadily increasing.

And to this steady progress of Science it is a matter of congratulation, that this Academy, notwithstanding the disadvantages under which we have laboured, from the little encouragement given to such pursuits in this country, has nevertheless contributed her full share. The Telescope of a noble brother Academician has opened to our view regions hitherto inaccessible, and still continues to give promise of further discoveries in Lunar and Stellar Astronomy. The Astronomical Observatory maintained at the private expense of another of our Members, in a distant part of Ireland, has also done good service; and the Markree Equatorial is already well known over Europe by the addition it has made to our catalogues of the stars,—a subject of such great importance now, when every year is giving us knowledge of new bodies forming a part of our solar system, comets as well as planets; for it is obvious that the discovery of such bodies will be greatly assisted by every addition that is made to our acquaintance with the place of the stars.

It would exhaust your patience were I to enter into a detail of the accessions contributed to this department of the Academy's labours, in the Physical and Mathematical Sciences; and it is the less necessary to do so, as this subject has been already brought before you, on occasions similar to the present, by those who were much better qualified for the task,—my predecessors in this Chair. I cannot, however, help saying, that even though we had not added, as we have, to the substantial results of Physical Science, this Academy would have done its duty, in this the highest branch of its studies, had it done no more than contribute to the powers of mathematical calculus the noble science of Quaternions. The labours of MacCullagh, of Robinson, of Apjohn, of Griffith, whom I name as types of their respective departments, without intending any invidious distinction above others who deserve to be named even with

them—their labours, and those of Hamilton himself in Mathematical Physics, have been carried on by the aid of those instruments of discovery we already possessed;—but the method of Quaternions is itself a new instrument, calculated to open to us new fields of research; and its importance in the future of Mathematical and Physical Science cannot, perhaps, be easily overrated.

Let me say also, before I pass from this topic, that we shall doubtless have great and valuable accessions to our knowledge of Botany and of Natural History in several of its departments, when Dr. Harvey returns from his present tour in the southern hemisphere of our globe. I have read to you, from time to time, some of the very interesting letters with which he has been so kind as to favour me; and I hold another in my hand, received a few days ago, which, however, I do not intend to read now, as I am unwilling to trespass too much upon the time of this Meeting. In it he tells me that he can hardly as yet say what amount of novelty his collections contain; he brings home, however, at least, two new genera, both curious and well marked, and several new species, of which he particularly mentions four new species of the Martensia, one of which, if I understand him aright, was obtained from the coral reefs of the Polynesian Islands.

II. In the department of Belles Lettres, or Polite Literature, as our charter entitles it, the last fifty years have also seen a considerable progress; the new science of Comparative Philology has been created in Germany, and English scholars have produced grammars and dictionaries of the learned languages, besides editions of the Classics, which have greatly promoted the spread of deep and accurate scholarship. In this country I am afraid we must candidly confess that classical learning has never had sufficient encouragement. How far the arrangements now in contemplation by the University to remedy this evil will be successful, time alone can tell; it would, however, be a great mistake to expect from them a complete or sufficient remedy. That they will do something may reasonably be hoped, but it is impossible that they can do all; and I cannot but express a very strong opinion that there is a current both within and without the University, which, if I mistake not, is running in the opposite direction. I allude to the tendency of

the present day to draw away young men from general classical and fundamental education, to a premature study of their future professional pursuits. This must necessarily produce superficial scholarship; it must diminish the number of those who can acquire any scholarship at all; and I doubt whether in the end it will be found favourable to professional attainments and eminence. To use the words of Bacon—"Ita fit, ut, more Atalantæ, de via discedant, ad tollendum aureum pomum, interim vero cursum interrumpant, et victoriam emittant e manibus."

But, notwithstanding the acknowledgement which truth extorts from us, that classical learning has never been sufficiently cultivated in Ireland, the one name of JAMES KENNEDY BAILIE amongst the Members of this Academy is enough to prove that we are not entirely without scholars of the highest order in this department. Nor has the Academy failed to add considerably to the common storehouse of learning, in that which may be regarded our more especial duty, the Language and Literature of ancient Ireland. The Irish Grammar of Dr. O'Donovan, his invaluable edition of the Four Masters, and his other publications, have won for him an European reputation; and it is with great pleasure and satisfaction that I take this occasion of announcing to the Academy, that he has recently received from the Royal Academy of Sciences of Berlin the high and well-merited distinction of being enrolled amongst the Honorary Members of that learned body.

It is to be admitted, however, that we have hitherto studied the ancient language of this country altogether in one aspect. We have studied it because it enabled us to disentomb from oblivion records of historical and topographical iuterest; but we have overlooked its philological and ethnographical importance in the great family of human languages to which it belongs. Neither have we considered or studied, as we ought to have studied, its ancient grammatical and radical forms, nor the relation in which it stands to the cognate dialects of Scotland, of Man, of Wales, of Brittany, of Cornwall. It is from a foreigner that we have received, what ought to have proceeded from our own scholarship, the most complete comparative Grammar of the Celtic languages that has ever been attempted since the time of Lluyd; and when our illustrious hono-

rary associate, Dr. Grimm, recently applied to us for information on a question of great interest, respecting the ancient forms, or what he conjectures to have been ancient forms of some Celtic dialect, he found us unable to reply.

The fact is, and the admission is not without humiliation,—the study of the Irish language, even with the limited object of historical research, is still confined to but few of our Members; and, although the Academy, at a very early period of its labours, zealously directed their attention to this subject, and were seconded also by the Royal Dublin Society, but little was effected, owing to the great dearth of competent scholars, capable of such a task.* The learned historian of Galway, whose loss we have had so lately to deplore, was one of the first within our own recollection to draw our attention to the subject, by a step in the right direction—the publication, in our Transactions, of a curious collection of Irish deeds, and afterwards by the independent publication of his Irish Minstrelsy. Dr. Petrie, also, from time to time, brought before us many ancient relics in our Celtic language, and employed them in illustration of our history and antiquities, as, for example, in his invaluable Paper on the History of Tara Hill. But the largest contribution made of late years to this branch of literature we owe to the labours of the Irish Archæological and Celtic Society. This Society is to our Committees of Polite Literature and Antiquities what the Geological and Natural History Societies are to our Committee of Science:—an *ancilla*, to use a Baconian phrase, associated for carrying out more effectually one of the most imperative duties of this Academy. To all such Societies we should give the right hand of fellowship; we should consider them, in fact, as parts of the Academy, and their labours as our labours, seeing that these Societies are worked, for the most part, by our own Members. It is true, the publications of the Archæological and Celtic Society are mainly intended for the illustration of the history, genealogy, and topography of Ireland, but they must also be considered as an important contribution to the philology and lexicography of the Irish branch of the Celtic family of lan-

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* See a short account of what was attempted, in the Preface to vol. I. of he Transactions of the Royal Irish Academy.

guage. They have preserved and put forward, in a form easily accessible, a body of Irish literature, with accurate translations and critical apparatus, which cannot but afford valuable facilities to the future student of the language, and will undoubtedly contribute greatly to spread a knowledge of that language amongst philological inquirers.

There is, however, another project originated by this Society, to which I look forward as likely to give the most valuable impulse to the study of Celtic philology, and which I would earnestly recommend to the Academy, as an object eminently deserving of their countenance and support: I allude to the design of compiling and publishing a complete Dictionary of the Irish language. For this great national and literary undertaking the most ample materials have already been collected. All that is wanted is such encouragement and support from you and from the public as may render it possible to complete the publication without pecuniary loss or risk to those engaged in it. The labours of the Brehon Law Commission (a Commission, be it remembered, the importance of which was first urged upon Government by a memorial from this Academy) will supply a most valuable mass of materials to this great work. By the admirable arrangements adopted from the commencement of their labours, by the intelligence of their indefatigable Secretary, who is, I rejoice to say, also your Secretary; and by the application (under his superintendence) of the Anastatic press to the multiplication of copies of the transcripts made from the original MSS., a complete index will be formed, arranged alphabetically, of all the passages of the Laws, containing any obscure, or remarkable, or technical word; and the juxtaposition of these passages cannot fail to throw great light upon the meaning of such words, and will, probably, in a great majority of cases, make that meaning perfectly clear and certain.

But, besides this, the unceasing diligence of our most eminent Irish scholar, Mr. Curry, has collected, during the last quarter of a century, a still more important mass of materials. Mr. Curry has been in the habit of noting down, in the course of his extensive reading, every remarkable word that presented itself to him, transcribing the passage in which it occurs, and then arranging the

whole in a voluminous body of glossaries, the value of which to the philology of the Irish language cannot be overrated. For these glossaries contain not the words, in arbitrary spellings, with meanings given them according to the judgment or opinion or conjecture of any particular scholar, however eminent;—but full authorities are given at length for every orthographical form, as well as for every signification in which the words are found. And as we know the dates with tolerable accuracy of all or almost all the documents quoted, it is evident that this method supplies also a history of the word; it shows us at what period its grammatical forms underwent modification; it shows us at what period its significations may have changed.

Our late lamented associate, Mr. Hudson, to whose patriotism the Library of the Academy owes a valuable addition, deposited in my hands, before his death, the sum of £200 in Government securities, as a contribution towards the publication of the Irish Dictionary. This sum, with the interest since accruing upon it, which I have added to the principal, is all that is available in the way of funds for carrying out this important national object. I cannot, however, doubt that such an object will ultimately receive support from the literary public of Ireland; it is, I confess, my ambition to interest you especially in this project; I would fain induce you to encourage it with energy, and, imitating the example of the illustrious Academy of France, to enrich the literature of Europe, and do honour to yourselves, by the publication of a work which will, I am persuaded, do even more for the Irish language than the Dictionary of the French Academy has done for the language of France, and which might justly then be put forward with the prestige of your name, as the Dictionary of the Academy of Ireland.

III. In the knowledge of Archæology, including the kindred subject of Ancient Architecture, a progress has been made within the last half century, quite as great, although not so sensibly visible, or so easily perceived by the world at large, as the more brilliant discoveries of theoretical and practical science.

This improvement has been mainly due to the adoption of right methods of study,—to the adoption, in a word, of the Baconian philosophy, and the application of that philosophy to this branch

of learning. There may be, no doubt, still a few pedantic theorists who refuse to submit to these laws of investigation, who are collectors of antiquities in the spirit of a miser, for collecting's sake, without any reference to the end of such collections, the information they may furnish. Who, in the language of Pope,

"The inscription value, but the rust adore."

Such men may still exist, but they are no longer identified with archæological studies; they are no longer able, as they once did, to bring reproach upon a noble and ennobling science.

For the study of Antiquities is the study of man; it brings to light the manners and customs of our forefathers; it makes known to us the origin of our noblest institutions; it points out to us the causes of those defects in our institutions, which still, perhaps, impair their usefulness, and retard the progress of society; it fixes the chronology of historical events; it is essential to the interpretation of Holy Scripture, and of all ancient writings; it traces the infancy of the Arts and Sciences; it maps out the migrations of the human race, and records the gradual progress of civilization; in a word, it connects, as by a golden chain, the present and the past; and whilst it strikes that chord of our hearts which thrills with reverence for the old, it teaches us to estimate the mind of man, and his position in this world between time and eternity, not by any one particular phase or period of his history, but by examining him in the light as well as in the shade; by regarding him, when, ignorant of the use of brass and iron, his weapons were pointed with flint alone, and discharged with no greater impetus than that which his own feeble arm could bestow,—and again, beholding him directing the iron torrent of the mortar battery, or raining a ceaseless stream of fire from the broadside of the steam-ship.

And in the science of Archæology this Academy has made great and rapid progress. In the knowledge of the Antiquities and Architecture of our own country, this progress is very remarkable. I remember in one of the earlier volumes of our Transactions a paper on an ancient monumental inscription in the Irish language, of which a tolerably correct engraving is given. That inscription would not now present the smallest difficulty to any Irish scholar. It is, in fact, perfectly intelligible; yet the author of the paper alluded to labours,

by elaborate and far-fetched conjectures, to discover in it a Latin sentence; and the Committee of Antiquities of that day were unable to detect the error. The great change that has since taken place, I do not hesitate to say, is mainly due to the papers with which Dr. Petrie has enriched our Transactions. They are remarkable for the historical value of the conclusions they have established, and the varied and extensive learning they display,—but they are still more valuable as models of the true spirit in which inquiries of this description ought to be conducted. Nor is Dr. Petrie the only labourer in this great field of usefulness. We have also had an admirable specimen of a similar application of the true method of philosophical investigation to antiquarian research in the communications made to us by our Secretary, Dr. Graves, on the interpretation of the Irish Ogham inscriptions. I have reason to hope that he will soon be in a condition to make a further communication to the Academy, which will put beyond a doubt the truth of the conclusions he has already arrived at on that interesting subject, and which will throw considerable additional light on the true age of the Ogham inscriptions, and their connexion with the Runic monuments of the Scandinavian nations.

But it is not only in the study of our national antiquities that the Academy has contributed largely to the advancement of Archæological Science. The papers of Dr. Hincks, which have appeared in our Transactions and elsewhere, have placed him by common consent in the first rank of those who have successfully investigated the subject of greatest archæological interest of the present day,—the Egyptian and Assyrian monuments. It is only fair to Dr. Hincks, in speaking of his eminent services to this department of literature, to bear in mind that his position as the rector of a parish in a remote part of Ireland, with a limited income, and no power of consulting either the monuments themselves, or the books that might aid his researches, places him under a great disadvantage; and nevertheless, he has done more to elucidate the language of the inscriptions, and the chronology of the obscure sovereigns whose history they record, than those who have had the advantage of a daily access to the British Museum and to the Libraries of our Universities. Had circumstances permitted him to reside for any considerable time in

London, or even in Dublin, it is certain that his discoveries would have been far more rapid and important.

There is, however, another subject not immediately connected with the progress of antiquarian knowledge, which deserves to be noticed, because it has been a consequence of the great additions that have been made to our Museum within the last few years. I allude to the impulse that has been given to Irish art by the specimens of ancient jewellery that have been collected and brought into juxtaposition in the Academy's Museum. The elaborate ornamentation of the Cross of Cong, of the Domhnach Airgid, of the Fiacail Phadruig, of the Cathach—which the liberality of its owner, Sir Richard O'Donnell, has permitted us to exhibit—and of the various specimens of ancient brooches—especially that beautiful silver brooch which was presented to our Museum by the Dean of Clonmacnois—has, in various shapes, been reproduced; and under the skilful superintendence of our associate, Mr. West, and others, has been the means of creating a new school of Irish art, which has already given birth to numerous beautiful articles of jewellery that have become highly popular, and are purchased and carried off by strangers as characteristics and mementos of Ireland.

I have already occupied so much of your time, that I must be very brief in the few remarks with which I would conclude this Address.

The liberality of Government, called forth mainly by the exertions of my immediate predecessor in this Chair, has increased our annual Parliamentary Grant from £300 to £500; and the Academy has wisely devoted one-half of this increase to the augmentation of the Library, and the other half to the support of the Museum.

With so small a fund at our disposal it is necessary that we should not buy books at random, but that we should limit our Library to some special departments. It is generally agreed, I believe, that we should confine ourselves to the Transactions of learned Societies, many of which we can obtain by exchange, and to the collection of all books, old or new, which have any relation to the history, the geography, statistics, or condition, moral and political, of Ireland.

This being admitted, there are two things to which I shall call

the attention of the Library Committee. One is the removal and sale of such duplicates, imperfect books, or useless books, inconsistent with the limits alluded to, which may be found in the Library; and the other is the formation of a more complete catalogue than we now possess.

With respect to the Museum, the first thing to be done, when the cases are completed, will be to arrange the collection in the best manner, and then to prepare a descriptive Catalogue. We must look to the Committee of Antiquities to take active steps for effecting these important objects. The question of a pictorial catalogue of typical articles selected from the Museum, multiplied by photography for the purpose of being interchanged with other Museums, or scientific Societies, has already engaged the attention of the Committee. Such a catalogue, if it could be made to pay by the sale of copies any considerable portion of its expenses, would be a publication well worthy of the Academy, which could not fail to do good service in the spread of archæological science. But with the limited funds at the disposal of the Academy for such a purpose, the financial possibility of the work must, in the first instance, be carefully considered.

One of the most important measures that calls for the attention of the Council is the preparation of a new edition of the Laws and Statutes of the Academy. Since the publication of the last edition several alterations have been made from time to time in various clauses of the Statutes; there is therefore great difficulty now in ascertaining the actual law of the Academy without a diligent collation of the Minutes of the meetings in which such alterations have been agreed to. This collation would require an expenditure of time and labour that few can afford to give; and therefore the great majority of the Members of the Academy are practically in the position of being unable to ascertain to what laws they are pledged. To remedy this evil all that is necessary is to publish a new edition of the Statutes as they now exist; and steps have already been taken by the Council to do this with as little delay as possible.

And now it remains only for me to return you thanks for the patience with which you have permitted me to occupy so much of your time. To-night I must enter upon the responsible duties of the

high office you have intrusted to me. I must endeavour, so far as in me lies, to justify your choice; and at all events to show you, by my zeal for the progress and welfare of the Academy, that my best energies, such as they are, shall be devoted to your service. Our business here is not amusement, or relaxation, but the spread of learning, the communication of knowledge to each other, and to the public,—the interchange of that mutual encouragement, and sympathy, and support, which will enable us, each in his own department, to promote the great object of our Association,—the investigation and the discovery of Truth. Let a generous emulation to be foremost in this noble and glorious pursuit banish from our meetings all party spirit, all private differences. Our discussions will, I trust, be at all times conducted with manly freedom,—but even when we differ in opinion from each other, let us remember that the expression and calm discussion of such differences is one of the most important instruments for the discovery of Truth; and let our debates be an example of the philosophic spirit, which is most in accordance with the objects for which we are incorporated, which is, most agreeable also to the feelings of the polished gentleman and to the instincts of the enlightened Christian. Then may we hope that the meetings of the Academy may continue to be to others what they have already been to us, the means of forming deep and lasting friendships, the source of warm personal attachments, and of the highest intellectual enjoyment; and we may then hope for the more complete fulfilment of that noble aspiration, with which the accomplished Burrowes concluded his Preface to the first volume of our Transactions:—

"The GOD of Truth will look propitious on our labours, and a ray from Heaven shall light us to success."

Mr. Gilbert Sanders read a notice of some properties of solid figures revolving on axes in supports fixed at the surface level of fluids.

A sector of any solid figure which may be described by the revolution of any plane round an axis, if freely suspended by the axis on supports fixed at the surface level of any fluid,

and weighted and balanced till its descending force shall be equal to a power represented by half the specific gravity of the fluid,—it will lie on the surface of the fluid without any part being immersed; but if any of the fluid be afterwards withdrawn, the solid figure, or float, will descend in exact proportion to the quantity withdrawn, volume for volume, replacing by its own bulk the abstracted fluid, provided the quantity of fluid removed does not exceed the float in volume; and the float will again ascend in proportion as the abstracted fluid is restored. The float, so described, by its ascent and descent during the removal and replacement of the fluid, will maintain the surface level of the fluid at the original points.

To consider the foregoing proposition, let us suppose, in Fig. 1, MN a cistern of water, of which the surface level is

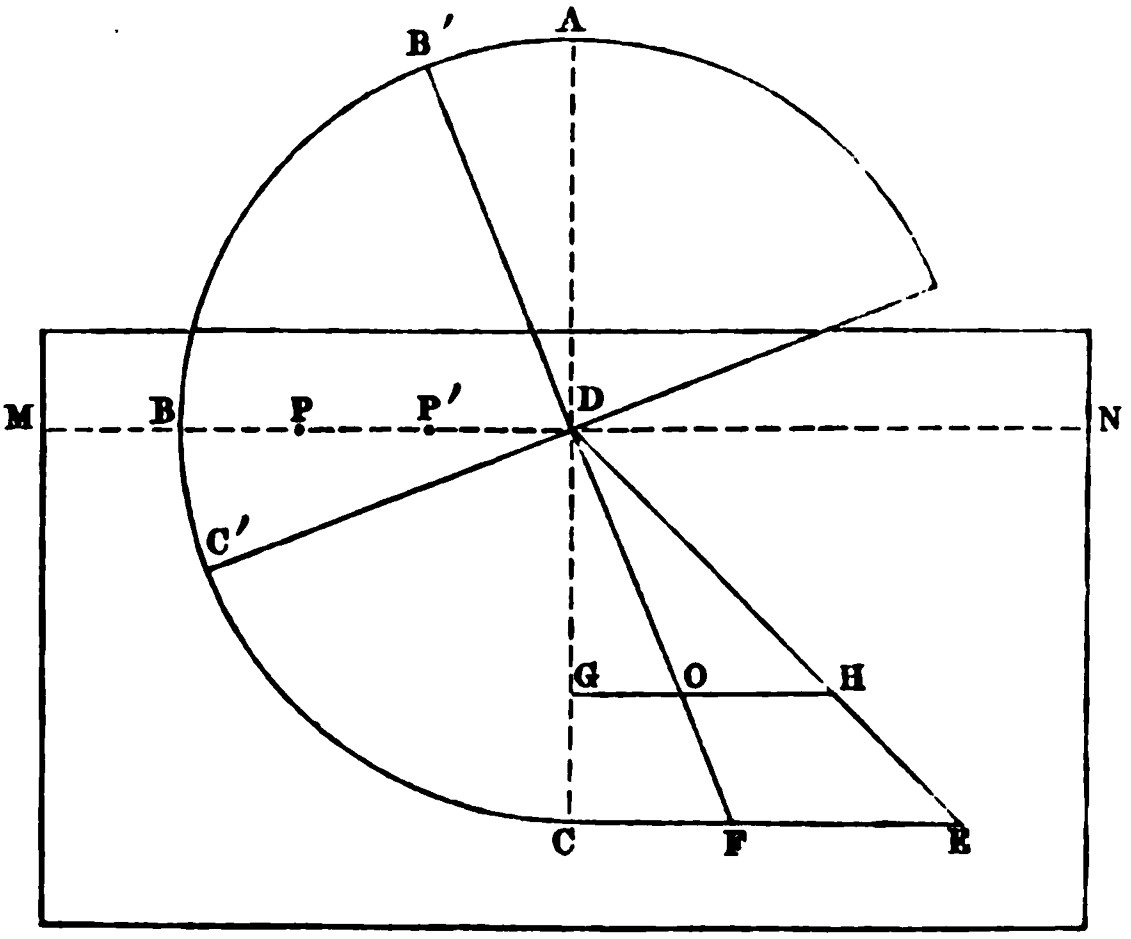

Fig. 1.

the line MN; let ABC be a sector of a semicylinder of any breadth, and the side AC perpendicular to the surface level MN. (Our remarks on the present occasion will be confined to the semicylinder, as that figure is the most suitable for our purpose.) Let D be the axis of the semi-cylindrical float,

turning freely on fixed supports at the surface of the water MN. Draw CE at right angles to DC, and equal to it. Suppose DC divided into any number of indefinitely small parts; the pressure on any part, as at C, will be as its depth from D, which is equal to the perpendicular CE; and similar perpendiculars, drawn from any other part, will be equal to the depth of such part, and the whole pressure on DC is represented by the triangle DCE. Bisect CE in F, and join DF; the centre of gravity of the triangle DCE is at two thirds of DF, from D at the point O, through which draw GH parallel to CE. The sum of all the perpendiculars, multiplied by their respective forces, is equal to the sum of all the forces multiplied by their mean distance, which is GO; and, therefore, the pressure may be considered as concentrated at O, and acting along the line GO, or at G, which is at two-thirds of DC from D, and, therefore, the force of the water pressing against the line DG, is expressed by two-thirds of DC, multiplied by the weight of a quantity of water represented by, or equal to, the triangle DCE. Now, it is evident that an equal pressure or weight acting perpendicularly at P, two-thirds of DB, from D, will balance the pressure at G.

Suppose the figure to have revolved about the axis D, till DC became DC′, and DB, DB′. The angles BDC′ and B′DA are equal, and their sines also equal; but the rotating power of any weight acting at any given point in BD is to its power at B′D as the sine of the angle made by BD with DA, and the pressure of the water on DC′ is as the sine of the equal angle BDC′, for the pressure on each of the parts into which DC was supposed to be divided is as their depths, or the perpendiculars let fall on them from the line BD, that is, as the sine of the angle BDC′; therefore, the pressure of the sum is likewise as the sine of BDC′, and consequently equal to the power of the weight at P on B′D, and they will balance each other in all positions, as the same may be proved of any position of the float.

Now, if the water sink below the level of BD, the pressure

on DC will be diminished and the balance disturbed; the weight at P will preponderate and cause the float to sink, making the water rise again until it reaches BD, as before, when the weight and pressure will balance each other. The converse of this is also true, as, if the water be raised above BD, the pressure on DC will be increased, the float will rotate in the other direction, raising it out of the water, and lowering the surface level till it once more reaches BD, and the balance will be restored, the water and the float remaining at rest.

If the semi-cylinder be homogeneous, its centre of gravity will be distant from the axis D, the cube of the radius divided by one and a half times the area of the semicylinder, which, if the radius be considered as 1, is about 0·4244; the distance of P from D is 0·6666 = that of G. A weight at P′ (0·4244 from D), to have an equal force with one at P′ (0·6666), must be inversely as their distances; therefore, the weight of the semicylinder, whose centre of gravity is at P′, is to the weight at P as 0·6666 to 0·4244. And, as the pressure at P, or G, is represented by the weight of a quantity of water equal in bulk to the triangle DCE, the specific gravity of the semicylinder will be inversely as its area to that of the triangle, and directly as their weights, or about one-half the specific gravity of the water. But if the weighting be applied at the circumference, as the centre of gravity of such an arc would be about the distance 0·6366 from D, multiplied by the radius, its aggregate weight should be to the homogeneous semicylinder as 0·4244 to 0·6366, which would be nearly one-third lighter than if homogeneously balanced; and that is the case, no matter what the breadth of the float: but the same does not hold if the figure be a hemisphere, as the centre of gravity of such a body is about 0·375 from its axis, and the centre of gravity of a hemispherical surface is at five-tenths of the radius, which is greater than the ratio given for the semicylinder.

The effect of expansion by heat is not very appreciable, however; if the semicylinder be employed for very accurate

investigations, the relative lengths of the radius and width of semicylinder may be proportioned so as to overcome the effect of difference of expansion of the material of the float and water. In Fig. 2, let BDC be a sector of a hollow metallic cylindrical

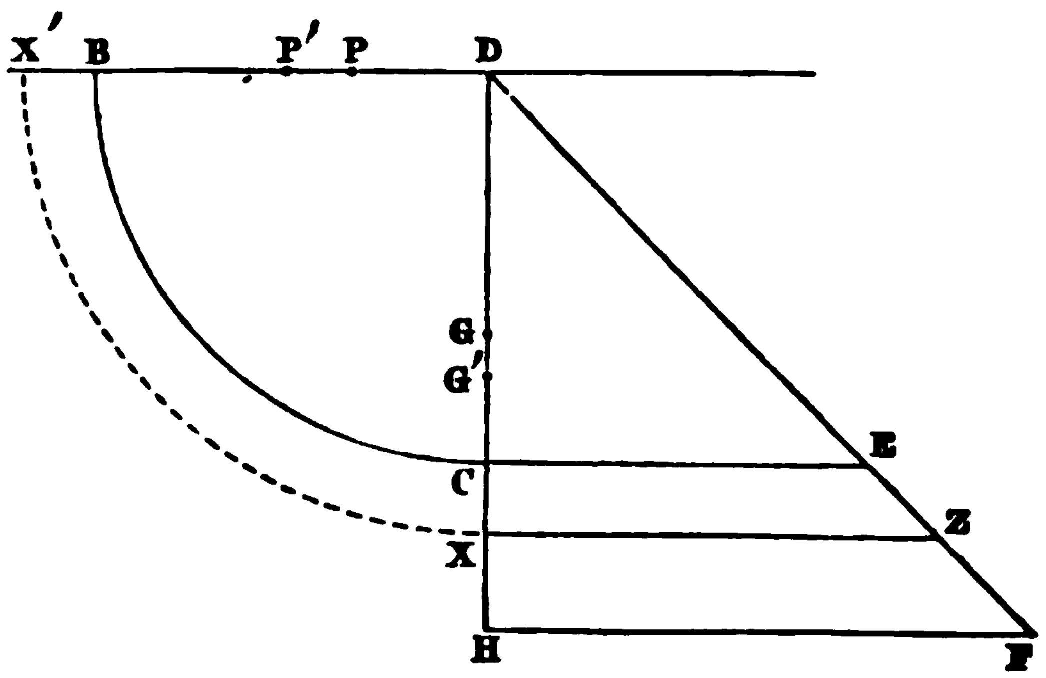

FIG. 2.

float; the triangle DCE represents the volume of water pressing against the side DC, supposed as the force concentrated at G. The rotating force acting on the axis D is the area of the triangle DCE, multiplied by DG, the distance of G from D, or $-\frac{DC^2}{2} \times DG$. Let us suppose the side of the float, and the column of water expanded, to X; the triangle DXZ represents the volume of water, its force concentrated at the point G′, to which G had been expanded; and the rotating force now acting at G′, is $\frac{DX^2}{2} \times DG'$, and as the point P also became P′ by expansion (equal ratio with G′), the balance is maintained; but water expands more than metals by equal increments of heat. Let H represent the point to which the water expanded, and the triangle DHF its volume, which is greater than DXZ, but only equal to it in weight; the rarefied volume of water DXZ, acting on DX′, will not balance the weight acting at P′; but, to keep the semicylinder in equilibrium during changes of temperatnre, the breadth must be so much longer than the

radius, as will, by its expansion, present a surface equal to the difference between the triangles, that is, the breadth must be to the radius as (the difference between the triangles divided by the expanded radius) is to the expansion of the radius.

In balancing the semicylinders, less or more weight may be employed to produce the same effect, provided the centre of gravity is further from the axis, or nearer to it; for instance, if the balancing for a homogeneously balanced semicylinder be placed at its centre of gravity, 0·4244 from the axis, it will be half the specific gravity of water; but if the balance be placed at half that distance, the *whole* weight will equal that of an equal bulk of water, and if at one quarter the distance, it will be double the specific gravity of water. Thus, the same effect is produced by bodies whose absolute weights are so different, that is, they will sink by the withdrawal of water below the surface level, or rise on any addition being made, though one may be much lighter than water, one equal to it, and one double its density. But if the weighting be made to act with a *force* greater than half the specific gravity of water, the power of such excess of weight acts as the whole weight, that is, as the sine of the angle of rotation; and if the whole of the float be elevated to the fluid level, by the withdrawal of a quantity of the fluid, the float will commence to descend, and, in doing so, actually raise the level of the fluid surface, producing the paradox of raising the height of fluid in a vessel by withdrawing a part; but the fluid will continue to rise only while the float is descending through the first quadrant, for, as soon as the point B, in Fig. 1, falls on the line of surface MN, the level will fall, and continue to fall during the further descent of the float through the second quadrant; the converse of this is also true.

The form of the float ought to be that of a figure generated by a plane revolving on its axis. If otherwise, let ABFC represent a parallelopiped, equal in weight to the semi-

cylinder ABC, Fig. 3, and having their centres of gravity coin-

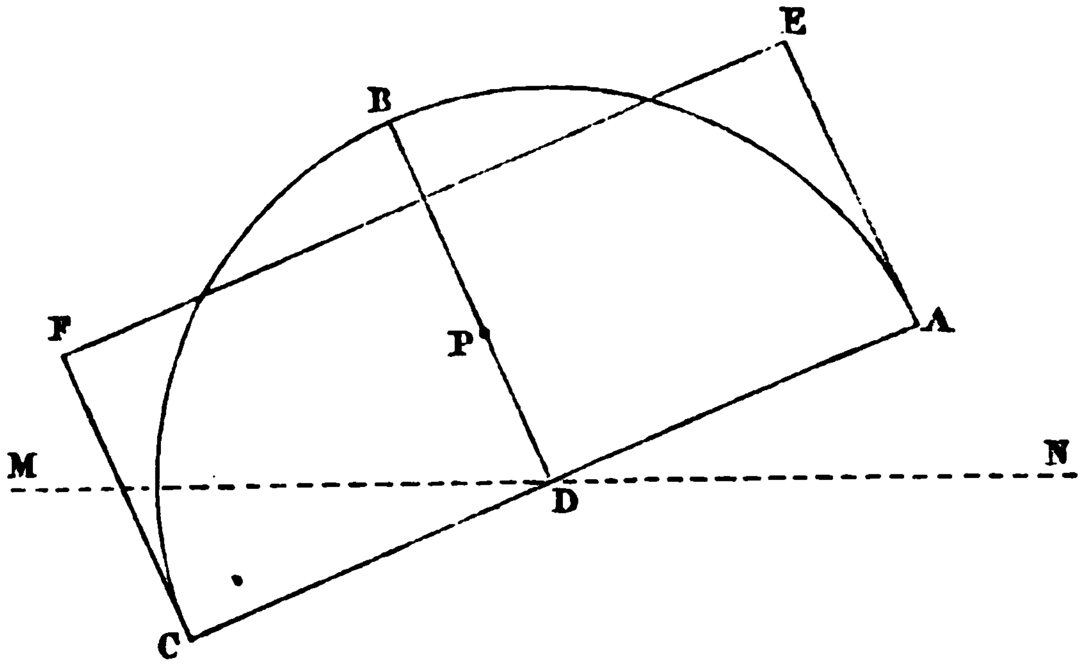

FIG. 3.

ciding. The pressure of the water on DC balances the weight of either of them, considered separately, but the pressure of the water on FC tends to make the parallelopiped rotate in the same direction as that on DC, which tendency not being in the same ratio for the angular motion as that exerted on DC, the two figures cannot act in the same manner, nor can any other figure, where the action on the periphery produces a rotating effect, except on the one given part DC. But a part, or parts, might be excentric in one direction, provided they be counteracted by others in an opposite direction.

The semi-cylindrical float described above is capable of being applied to many useful purposes; the delicacy of its action, when properly balanced, is such, that a solid body capable of raising the surface level in the cistern, in which the compensator may be placed, only 1-2000th of an inch, it will, on being gently plunged into the water, cause an elevation of the float quite visible, and indicating a movement, perhaps, equal to the bulk of the immersed solid. It is, therefore, applicable to the measurement of complicated structures, such as groups of crystals, or masses of other matter, and by it also specific gravities, expansion of solids, &c., may be ascertained with

great exactitude. Extremely small additions of fluid will be measured, as in the instance with the solid already mentioned, and, therefore, its utility as a rain gauge. I also find that, by plunging one end of an open tube, bent at right angles, into the water in the cistern, allowing the wind to act upon the other end,—the surface of the water in the rest of the cistern, and the float, being protected from the influence of the wind,—the float will ascend in exact proportion to the force of the wind, depressing the water in the tube. I have one of these instruments so sensitive that mere breathing or speaking in front of the open end of the tube will act on the float. It has also occurred to us, that a solid cylinder of iron placed in a properly formed cistern of a barometer, would keep the level of the mercury in the cistern constant during the ascent and descent of the mercury in the tube, and would save much trouble in determining the true difference of height of a column in the barometer, which could always be read off at once on the scale without any allowance for difference of level; the surface level of the cistern being maintained to the 1–2500th of an inch by the action of the float.

Since I became acquainted with the properties of the rotating float, my friend, Mr. Richard E. Donovan, who first introduced it to my notice, has informed me that he has recently heard that a similar float had been proposed many years ago as a method for maintaining the oil level in a lamp. However, if that be true, the valuable properties it possesses as a hydrostatic balance could not have been investigated, otherwise it would not have been forgotten. I must here acknowledge the obligations I am under to Mr. Donovan, for the part he took in carrying on the experiments and the calculations necessary for this paper.

The President presented to the Academy, on the part of the present Earl of Charleville, a portrait of his grandfather,

William Bury Earl of Charleville, who was President of the Academy from 22nd June, 1812, to 16th March, 1822.

The President was requested to convey to the Earl of Charleville the special thanks of the Academy for his handsome gift.

Rev. J. H. Jellett, Secretary of the Council, presented the first ten volumes of "Liouville's Mathematical Journal" to the Library of the Academy.

The thanks of the Academy were voted to the Secretary of the Council for his valuable gift.

Monday, April 28th, 1856.

JAMES HENTHORN TODD, D. D., President, in the Chair.

Mr. E. Clibborn, by permission of the Academy, read a paper on the identity of the chronological system of the priests of Memphis, as explained to Herodotus, and the succession of the kings of Egypt, attributed to Manetho.

The object of the author was, in the first place, to show that a critique on Herodotus in the "Royal Irish Academy Transactions," vol. xxii. Pol. Lit. p. 49, was not applicable either to the chronology of the reign of Sabacon, or Anysis, which appears to precede it, and of Sethos, who was a contemporary of Sabacon; and, in the second place, to prove that the royal chronology of the Egyptian priests at Memphis and Heliopolis, and especially at the latter place, as it was explained by a reference to a series of images there of 345 statues of Pironeses, was, in theory, identical with Manetho's system of chronology to the end of the twenty-sixth dynasty, or the beginning of the Persian dynasty, in whose time both Hecatœus and Herodotus visited Egypt.

It was explained, that according to the corrected lists of Manetho's dynasties, the actual number of reigns of all the kings of Egyptian and of foreign origin, including Sabacon and two other Ethiopian kings, and one queen's reign, in Egypt, was 346 *only* to the Persian Conquest; and thus, the total numbers of reigns of kings, of Pironeses at Heliopolis, and of priests at Memphis, as explained to Herodotus, were the same up to the Persian dominion, as the number of reigns stated by Manetho.

It was also explained, that Bunsen, in the exposition in his "Egypt's Place," &c., vol. i. p. 105, of what he erroneously calls Herodotus's view of the chronology of Egypt, had fallen

into a great mistake in supposing that the *stone* statue of Sethos (Smintheos) in the Temple of Vulcan, at Memphis, was to be counted with the 341 (or 345 ?) *wooden* images in the storehouse there, and that the count of the number of reigns of kings, of priests, and of generations of men in Egypt from Menes, was to be carried down *only to the time of Sethos*, the contemporary of Sennacherib, and not to Amasis of the twenty-sixth dynasty.

A statement preserved by Herodotus, but overlooked by Bunsen and all other modern writers, as to the interval of time between the construction of the mound of Anysis, and its discovery by Amyrtæus, was adduced to prove that an interval of at least 300 years existed between the reign of the king called Anysis, and Sethos, or Sabacon; so that the events of the reign of Anysis are not to be considered as immediately preceding the reign of Sabacon, as is generally supposed by modern writers, who have overlooked the fact of an interval of 700 years between Anysis and Amyrtæus. Thus, it was proved that Herodotus's statements concerning Anysis do not immediately precede Sabacon, who is mistaken in his present text for another king of Cuthean, but not of African origin, whose name or title was Saba, identical with that of the enemy of "the son of Anosh," of the Arabs, who may be identified with Anysis of Herodotus.

It was shown that the two Ethiopian kings—who, with or after Sabacon, ruled in Egypt,—the shepherds or Hycsos, and the Shethites, or blue-eyed kings of the monuments,—belong to the group of seventeen kings, called altogether, with Sabacon, by the Egyptian priests, eighteen Ethiopians, in the text of Herodotus—to a great extent, fill up the gap of 300 years between Anysis and Sabacon; whose reign, probably in his own country, may have subtended the reigns of his son and grandson, Sabacus and Tirhaka, in Egypt: and thus, the author maintained, we might reconcile the statements in Herodotus with matters of fact which followed Sabacon's actual rule in Egypt.

The appointment of Sethos, probably in the place of Bocchonis, to the chief rule in Lower Egypt, at Sais, was considered to have been an act of the Ethiopic king or kings of the day.

It was denied that Sethos could have been a priest of Vulcan at all; and that, where he is so called in the present text of Herodotus, the words are redundant, and altogether contradict facts stated elsewhere in Herodotus; and hence we are obliged to reject the title of priest "of Vulcan," and call Sethos simply a priest or a prophet of a "*god*," or "*gods*," whose proper name, if known, would not have been mentioned by Pagan priests, who, by calling the prophet, Sethos, attributed his gifts to Typhon, or Seth, the evil genius of the neighbourhood of Pelusion, according to Egyptian superstition.

The analogy in the description, by Herodotus, of the vision of Sethos with one of the two visions of the prophet Isaiah, led the author to identify the party called Sethos by the priests of Vulcan, at Memphis, by the diabolical title Sethos, with the Jewish prophet Isaiah, or E-Sais; and adopt Herodotus's statements as explanatory of the means adopted by Providence for the fulfilment of the prophecy, that the Assyrians should not shoot an arrow or raise a shield at Jerusalem. It was also shown, that the statements in Herodotus, taken in connexion with the Biblical notices of Sennacherib's defeat, and a quotation from Berosus preserved by Josephus, that the mode of the first discomfiture of Sennacherib at Pelusion was exactly the same in kind with that of the Midianites and their allies,—the different nations, Arabs, Assyrians, Medes, and Persians, composing Sennacherib's army, having quarrelled and fought with each other with their swords, and without shields. To this battle Herodotus refers, when he notices the bones of the people he saw at Pelusion who fell on the occasion of the discovery of the depredations committed by the mice on their bow-strings and shield-handles, during the night after the arrival of the army before Pelusion.

These explanations were offered to save Herodotus's reputation from the critique quoted from the Transactions, so far as it related to the real period of Sabacon, and of the reign which appears to precede it, and that which was, at least in part, contemporary with it and after it; and to prove the general accuracy of Herodotus as a reporter of statements made to him by the Egyptian pagan priests, and others; and as suggestive of the omission of a few words in his text, which appear to have been introduced into it by some Arab critic who understood Greek, but who had no knowledge of chronology, or of Manetho's dynasties; and the identity in duration of the chronology of the priests at Heliopolis and Memphis, with that of the priest of Sebennytis in the time of Ptolemy II.

In conclusion, it was shown, that the particular facts, said, in the critique referred to, to be undeserving of the slightest credit, were on the contrary, worthy of the special notice of Biblical scholars, as being supplementary to facts recorded in the Scriptures, which in themselves are insufficient to realize the historical identities of the "son of Anosh," as a king, both before and after his retreat to the Ausitis. The few words in Herodotus relating to this prince just supply the *desiderata* which give him an historical reality in time and place, and indicate his position in the monuments as the foster-brother of Horus, or the Hawk, of the eighteenth dynasty of Manetho, and not as the immediate predecessor of Sethos.

The notices of Sethos, in the text of Herodotus, are invaluable, as they supply everything that is necessary to explain the facts of Sennacherib's discomfiture, and how it was that the prophecies relating to that event were all of them completely fulfilled, "here" at Pelusion, where Isaiah or Sethos was, and "there" at Jerusalem, where Hezekiah was when he sent the embassy to Isaiah. By the identification of Sethos and Isaiah, the notices of this prince in Herodotus at once open the way to the grouping together of a number of other fragments

of the personal history of Isaiah, to be found elsewhere; and as these are numerous, extending backwards to his infancy, and are quite consistent with other facts and references in the writings of Isaiah, we thus become indirectly indebted to Herodotus for a biography of the chief of the prophets, about whose personal history so little has been preserved by the Jewish writers, though he really appears to have been one of the most extraordinary characters who ever appeared in Eastern history.

Dr. John B. Barker read a paper on the stomach of the zebu.

The Secretary of the Academy announced a donation of two copies of a large medal in copper and silver, struck by the order of George V., King of Hanover, in honour of Carl F. Gauss, and presented to the Academy by order of His Majesty, through the Royal Society of Göttingen.

Monday, May 12th, 1856.

JAMES HENTHORN TODD, D.D., President, in the Chair.

Thomas H. Ledwich, Esq., and John H. Otway, Esq., were elected Members of the Academy.

The Rev. John H. Jellett read a Paper, by Mr. Thomas J. Campbell, on the solution of cubic equations.

"To resolve the cubic equation,

$$x^3 + ax^2 + bx + c = 0,$$

put $x = x' + z$, and the equation becomes

$$x'^3 + (3z + a)\,x'^2 + (3z^2 + 2az + b) \times x\,(z^3 + az^2 + bz + c) = 0,$$

which may be proved by development, for

$$\begin{aligned} x^3 &= x'^3 + 3zx'^2 + 3z^2x' + z'^3 \\ ax^2 &= \quad\quad ax'^2 + 2azx' + az^2 \\ bz &= \quad\quad\quad\quad bx' + bz \\ c &= \quad\quad\quad\quad\quad c \end{aligned}$$

$$\therefore x^3 + ax^2 + bz + c = x'^3 + (3z + a)x'^2 + (3z^2 + 2az + b)x + z^3 + az^2 + bz + c.$$

Call the member on the right and left of this equation fx and $f'x$ respectively:

$$\therefore f'x = x'^3 + (3z + a)\,x'^2 + (3z^2 + 2az + b)\,x' + (z^3 + az^2 + bz + c) = 0.$$

My object is to reduce $f'x$ to the form of

$$x''^3 + Ax''^2 + \tfrac{1}{3}A^2x' + c' = 0,$$

where $x'' = f'x$ (or another function of $f'x$), and thus to find x'' by completing the cube, for a similar reason as we complete the square in equations of the second degree.

"But to effect this important relation of the coefficients

of $f'x$, so as to reduce it to the form I have mentioned, we will divide both sides by

$$(z^3 + az^2 + bz + c)\,x'^3,$$

and thus we will have a new form of the equation in these terms, viz. :—

$$x'^{-3} + \left(\frac{3z^2 + 2az + b}{z^3 + az^2 + bz + c}\right)x'^{-2} + \left(\frac{3z + a}{z^3 + az^2 + bz + c}\right)x'^{-1}$$

$$+ \frac{1}{(z^3 + az^2 + bz + c)} = 0,$$

which is an equation the roots of which are the reciprocals of those of $f'x$. Now, let me compare the model equation

$$x''^3 + Ax^2 + \tfrac{1}{3}A^2x' + c$$

to the above, and we see that

$$A = \frac{3z^2 + 2az + b}{z^3 + az^2 + bz + c};$$

also

$$\tfrac{1}{3}A^2 = \frac{3z + a}{z^3 + az^2 + bz + c};$$

or

$$A^2 = 3\left(\frac{3z + a}{z^3 + az^2 + bz + c}\right) \therefore \left(\frac{3z^2 + 2az + b}{z^3 + az^2 + bz + c}\right)^2 = 3\left(\frac{3z + a}{z^3 + az^2 + bz + c}\right);$$

or, by development and clearing of fractions, we get the following function of z, viz. :—

$$(3z^2 + 2az + b)^2 = 3\,(3z + a)(z^3 + az^2 + bz + c)$$

$$\left\{\begin{matrix} 9z^4 + 12az^3 + (6b + 4a^2)z^2 \\ + 4abz + b^2 \end{matrix}\right\} = \left\{\begin{matrix} 9z^4 + 12az^3 + (9b + 3a^2)z^2 \\ + (9c + 3ab)z + 3ac \end{matrix}\right\}.$$

Hence, by contraction or transposition, we get the following quadratic :—

$$(3b - a^2)\,z^2 + (9c - ab)\,z + (3ac - b^2) = 0.$$

Hence

$$z = \frac{-(3b-a^2) \pm \sqrt{\{(3b-a^2)^2 - 4(3ac-b^2)(3b-a^2)\}}}{2(3b-a^2)},$$

but in the equation

$$x''^3 + Ax''^2 + \tfrac{1}{3}A^2x'' + c' = 0, \quad x'' = -\tfrac{1}{3}A + \tfrac{1}{3}(A^3 - 27c')^{\frac{1}{3}},$$

by completing the cube, and transposing c. Therefore, also,

$$x'^{-1} \text{ or } \frac{1}{x'}$$

$$= -\tfrac{1}{3}\frac{3z^2+2az+b}{z^3+az^2+bz+c} + \tfrac{1}{3}\left\{\left(\frac{3z^2+2az+b}{z^3+az^2+bz+c}\right)^3 - \frac{27}{z^3+az+bz+c}\right\}^{\frac{1}{3}}$$

$$\therefore x'$$

$$= 3\left\{-\frac{3z^2+2az+b}{z^3+az^2+bz+c} + \sqrt[3]{\left(\frac{3z^2+2az+b}{z^3+az^2+bz+c}\right)^3 - \frac{27}{z^3+az^2+bz+c}}\right\}^{-1};$$

but $x' + z = x$, by the hypothesis in the original equation:

$$\therefore x = x$$

$$+3\left\{\frac{(3z^2+2az+b)}{z^3+az^2+bz+c} + 3\left(\frac{3z^2+2az+b}{z^3+az^2+bz+c}\right)^3 - \frac{27}{z^3+az^2+bz+c}\right\}^{-1};$$

consequently, substitute the foregoing value of z into this last formula, and it gives the value of the unknown quantity in any cubic of the form that I proposed."

Rev. Professor Haughton made a communication "On the Depth of the Sea deducible from Tidal Observations," of which the following is an abstract.

He stated that, in consequence of his having succeeded in separating the effects of the sun and moon in the diurnal tide, he was enabled to make calculations of the depth of the sea in which the tidal wave was produced, which he believed to be worthy of the greatest attention. The depth of the sea may be inferred from three distinct observations, viz., of heights of diurnal tide; of solitidal and lunitidal intervals; and of the age of the lunar tide compared with the lunitidal interval.

The calculations founded on the last two methods gave respectively 11·9 miles and 11·3 miles, each result being a mean of those derived from eight stations, agreeing remarkably well with each other.

The calculation founded on heights gave as a result a depth of 5·12 miles, agreeing with a result deduced by Laplace from the long series of Brest observations on the semidiurnal tide, viz., 5·07 miles.

Mr. Haughton was of opinion that the first result, viz., 11·6 miles, is the depth of the central channel of the South Atlantic, up which the tide waves advance from the Antarctic Ocean; while the second result, viz., 5 miles, deduced from heights, represents the mean depth of the whole Atlantic Ocean, including the shallow water of the soundings in the eastern portion, near the British Islands. This view he considered to be confirmed by the great age of the diurnal tide, viz., five to six days,—a circumstance which shows the great distance from the coast at which the tide wave is formed, which gives the character to the diurnal tides of the Irish coasts.

Monday, May 26th, 1856.

JAMES HENTHORN TODD, D.D., President, in the Chair.

Mr. W. R. Wilde read a Paper on the introduction and the time of the general use of the Potato in Ireland,—and its various failures since that period; with some notice of the substance called Bog-butter.

"Some few years ago, having turned my attention to the subject of the 'Food of the Irish,' especially in early times, and written some essays upon it in the 'Dublin University Magazine,' (see Numbers for January and March, 1854), the potato came, in due course and chronological order, under consideration. Having looked into the authorities which bore upon the subject of the early introduction of the potato into Ireland, I then arrived at the conclusion that it became an article of general food, and consequently, as such, was the means of influencing —as far as the mode of producing food, and the constituents and character of that food could be the means of influencing—the moral, physical, social, political, and commercial condition of the people about the middle of the seventeenth century. My attention was again called to the subject by the publication of Mr. Macaulay's 'History of England,' in which he mentions the potato as influencing the feelings and character of the people during the period over which his third and fourth volumes extend. He has twice mentioned the potato (vol. iii. p. 158, and vol. iv. p. 110), and in one instance under very peculiar circumstances—at the siege of Limerick. The beleaguered city, having stood out to the last, capitulated, and then a memorable scene took place—a scene well worthy the attention of the painter and the poet,—on each side of the gate stood the generals of the respective armies, with their attendants; out

marched the soldiers of the garrison to choose their destiny;—and Mr. Macaulay, in describing this scene, took occasion to state—among the various circumstances that influenced the minds of the men who were then either to expatriate themselves, or to remain under what they considered a foreign yoke—the remembrance of their homes, their *potato garden*, and their clamp of turf, with other attractions of a like nature, which still sway the Irish peasantry.

"Recently Dr. John Davy wrote me a letter, in which he questioned this early use of the potato as the general food of the people, on account of the statement in the 'Great Geographical Dictionary,' published in 1694, that, 'in hard times, they [the Irish] lived on water-cresses, roots, mushrooms, shamrocks, oatmeal, milk, and such other slender diet.' I have again looked into some authorities to see whether the views of Dr. Davy are supported, or those which I myself had expressed in the Dublin periodical alluded to, and in which I stated, that in Munster especially the potato formed the staple food of the Irish about the middle of the seventeenth century. The writer in the 'Geographical Dictionary' probably took Spencer and Campion, who wrote more than a century before, as his authorities.

"Some difficulty has attended the investigation of this subject, from the circumstance of inquirers not distinguishing between the true potato, *Solanum tuberosum*, and the 'sweet potato,' *Convolvulus batata*, or, as it is sometimes called by old writers, the Spanish potato.

"It is generally believed that Sir Walter Raleigh introduced the potato into Ireland. Sir Joseph Banks came to the conclusion when he wrote his Essay (being an attempt to discover the time in which the potato was introduced into the British isles) that it was brought by Raleigh into England, and from England into Ireland about the year 1600. It must have been at least before the year 1602, because the estates of Raleigh then passed into the Boyle family, and his connexion with Ireland ceased.

"Clusius, the botanist of Leyden, who wrote in 1586, says the potato was cultivated in Italy prior to that date; and Cuvier denied that Europe derived the potato from Virginia. The researches of Banks also favour this conclusion, and he states that Coccius, in his Chronicle, printed in 1553, mentions potatoes under the term of *papas*. Herriott, who accompanied Raleigh's expedition to Virginia, described them under the name of *openawk*. In Irish they are variously styled *potatee*, *pratea*, or *phottie*, mere Hibernicisms of the English word 'potato.' Sir Robert Southwell, President of the Royal Society, stated, at one of its meetings in 1693, that potatoes had been introduced into Ireland by his grandfather, who first had them from Sir W. Raleigh.

"I would now ask, what had the people to live on in Ireland before Raleigh introduced the potato? While most other nations have had their history transmitted from the days of the hunter and the fisher, clothed in skins, and using weapons either for the chase, their own preservation, or the production of food, and so rising in the scale of civilization from barbarism to the highest amount of cultivation, in which the arts were made subservient to the food as well as to the ornament and education of man—we find this curious fact, that there is no record of such a state of existence in Ireland. The Irish had mills and 'pure white wheat,' and a coexistent state of civilization of which that was but a small portion; because, to raise and to grind corn, and to bake it into bread, was comparatively an advanced state of society. We had in Ireland at that time a social state very different from that alluded to, as being the character of other nations in similar phases of development, and which serves to confirm the idea that we are in all probability descended from a colony previously civilized, which had settled in this country.

"The people lived, in early times, upon corn and milk, and also upon the flesh of oxen and swine—the latter is shown by the details of feasts and royal banquets, descriptions of

which were favourite themes for the recitals of the early bards. Subsequently sheep appear to have been introduced; goats were likewise domesticated, and the remains of domestic fowl have been discovered in early tumuli—a circumstance which upon a former occasion I brought under the notice of the Academy. Corn, peas, beans, and possibly parsnips, with cabbages and onions, formed the vegetable food of the people, prior to the introduction of the potato.

"Gerard, the English herbalist of 1597, is one of the first authors who alludes to the potato, and after him Richard Bradley, F.R.S., in his 'Planting and Gardening,' published in 1634. At a meeting of the Royal Society, in March, 1662, a letter was read, containing a proposal for preventing famine, by dispersing potatoes throughout all parts of England;—this subject is alluded to in Evelyn's 'Sylva.' Threlkeld, the Irish botanist, described the plant in 1726, and says we had it through Thomas Herriott. The late Crofton Croker, in the introductory matter to his 'Popular Songs of Ireland,' has given some very interesting references to the early authorities respecting the introduction of the potato into Ireland, and Mr. MacAdam, of Belfast, has likewise written a valuable treatise on the subject in the 'Quarterly Journal of Agriculture,' for June, 1834–5. 'That potatoes were ordinary food in the south of Ireland,' writes Mr. Croker, 'before the time of the Commonwealth, is shown by "An Account of an Irish Quarter," printed in 1654, in a volume entitled "Songs and Poems of Love and Drollery," by T. W. The writer and his friend visited Coolfin, in the county of Waterford, the seat of Mr. Poer, where at supper they were treated with codded onions, and in the van—

'Was a salted tail of salmon,
And in the rear some rank *potatoes* came on.'

"But although sown in gardens as a rarity, and used at supper as a delicacy, we have no authority for believing that

the potato had become the general or principal food of the Irish peasantry until the middle of the century. That, however, the cultivation of the plant was making rapid progress, may be learned by reference to Cole's 'Adam in Eden, or the Paradise of Plants,'—published in London in 1657, which says:—'The potatoes which we *call* Spanish [not the sweet potato], because they were first brought up to us out of Spain, grew originally in the Indies, where they, or at least some of this kind, serve for bread, and have been planted in many of our gardens [in England], where they decay rather than increase; but the soyle of Ireland doth so well agree with them, that they grow there so plentifully that there be whole fieldes overrun with them, as I have been informed by divers souldiers which came from thence.'* The soldiers alluded to by Cole were those of the Parliamentary forces engaged in Ireland from 1649 to 1653, during a period when Sir William Petty calculated that 616,000 of the Irish and the English in Ireland died by the sword, famine, and pestilence.

"In a paper published in the 'Philosophical Transactions' in 1672, and believed to have been written by Dr. Beale, concerning a strange frost which occurred in England in that year, we read that—in 1629 or 1630 there was a dearth in England; and 'much talk there was then that in London that the had a way to knead and ferment boyled turnips, with a small quantity of meal;' and then he goes on to say, 'potadoes were a relief to Ireland in their last famine; they yield meat and drink.' This famine was evidently that alluded to by Petty in the foregoing reference.

"From the researches which I have made it would appear that the cultivation of the potato was very irregular throughout the country; some localities, especially in Ulster, having only adopted it generally within the memory of the past generation. M'Skimmin, in his 'History of Carrickfergus,'

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* I am indebted to our Treasurer, R. Ball, Esq., for Cole's rare book.

asserts that not more than two generations back potatoes were seldom used after harvest.

"In 1663 Mr. Boyle exhibited some specimens to the Royal Society of London, and read before that body a letter from his gardener at Youghal (the cradle of the potato), in which he describes this esculent as 'very good to pickle for winter salads, and also to preserve. They are to be gathered in September, before the frost doth take them;' and, after describing the best mode of culture, he continues—'I could speak in the praise of the root, what a good and profitable thing it is, and might be to a commonwealth, could it generally be experienced, as the inhabitants of your town can manifest the truth of it.' One would think from this passage that the potato had not then become an article of common food amongst the Irish, beyond the locality where it was first cultivated. Sir William Petty, in his 'Political Anatomy of Ireland,' written in 1672, although not published until 1691, enumerates among the articles of food, 'potatoes from August till May; muscles, cockles, and oysters near the sea; eggs, and butter made very rancid by keeping in bogs;' and in another place he asserts—'that six out of every eight of all the Irish feed chiefly upon milk and potatoes.'

"Certainly the present great historian of England has ample authority for the statement that the potato was cultivated in Ireland to such an extent as to influence the character and feelings of the people, so early as 1689; for, in addition to those authorities already referred to, it is stated in Durfey's 'Irish Hudibras,' published in the May of that year, and in which the esculent is frequently referred to, that after the arrival of William III., the natives are said to have been prevented enjoying their 'Banni-clabber [thick milk] and pottados.' John Dunton, likewise, in his 'Conversation in Ireland,' published in 1699, describes the Irish cabin in his day as having behind it 'the garden, a piece of ground, sometimes of half an acre or an acre, and in this is the turf-stack,

their corn, perhaps two or three hundred sheaves of oats, and as much peas; the rest of the ground is full of their dearly-beloved potatoes, and a few cabbages.' And again, describing the habits of the people generally from Galway to Kilkenny, he says, 'Bonny-Clabber and Mulahaan, alias sowre milk and choak-cheese, with a dish of potatoes boiled, is their general entertainment;' also in the 'keens' of that day, allusion is made to the 'pigs and potato garden.' Moreover, John Haughton, who published his 'Husbandry and Trade Improved' in 1699, when describing the growth of the potato in Ireland, says, it has 'thrived very well and to good purpose, for in their succeeding wars, when all the corn above ground was destroyed, this supported them; for the soldiers, unless they had dug up all the ground where they grew, and almost sifted it, could not extirpate them.'

"As experience has proved the potato to be one of the most fickle of vegetables cultivated to the same extent, the most likely to suffer from atmospheric vicissitudes, and the most liable to disease—one would think that if it had been cultivated in Ireland to such an extent as to constitute the most material portion of the food of the people, its failures would have been noticed in history, contemporaneously with those other losses of food which have been recorded. It is possible, however, that in the earlier years of its general introduction, this crop was not so liable to disease as in later times. In 1725, the use of the potato was so general (at least in parts of the country) as to form nearly the whole winter food of the poor (see Primate Boulter's Letters).

"The first great destruction of the potato crop occurred in the winter of 1739–40, and was attributed to the early, very severe, and long-continued frost of that period. There had been a very wet summer and autumn in 1739; and although the frost, no doubt, was one of the chief causes of its destruction, I am inclined to think that the potato failures in 1739, '40, and '41, were not altogether attributable to the

severity of the winters. When the great frost broke out in the November of 1739, and which increased in intensity during the following month, all the potato crop not already used was in the ground, either undug, or in pits with such a loose covering of earth as was penetrable to the frost. It was said that the potato crop was destroyed in one night; and that 300,000 people perished of famine resulting therefrom. In 1741 the people were cautioned against eating potatoes, which were believed to be diseased, and likely to produce disease in man.*

"The following list of failures in the potato shows how little reliance can be placed on that esculent as the sole food of a nation:—

"1765. A series of unusual wet seasons preceded this year, which was memorable for the quantity of rain which fell in the early part of it, and the excessive drought of summer; potatoes failed; they were scarce and small; as occurred again, under like circumstances, in 1826.

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* Since the foregoing was read to the Academy, I have received the following note from Mr. Curry on the subject:—

"During my residence in London, in the summer of last year (1855), I fell in with a curious Irish poem of several stanzas, in the handwriting of the author, John O'Neachtan, an Irish scholar, well known in and about Dublin, between 1710 and 1750.

"The poem gives a vivid and most graphic description of a battle supposed to have been fought at Cross-bride, somewhere about Tallaght, in the county of Dublin, in the year 1740, between the farmer advocates of the potato, which had been nearly annihilated in the preceding year by the great frost, and the market gardeners and others, who gloried in the destruction of the foreign root, and gave a disinterested preference to the growth of the less prolific and more inaccessible edibles of barley, beans, peas, rye, cabbage, &c.

"The part of this description which may prove of interest to you is that in which the writer always speaks of the potato as the white Spaniard, *Spaineach Geal*, that is, the white or generous-hearted Spaniard; and where he says that they gladdened the people's hearts from the first day of August till Patrick's day."

"In 1770 there was a potato failure, attributed to the *curl*, or disease in the leaves.

"In 1779, Arthur Young informs us that in some of the northern counties the people sprinkled their potato land with lime, in order to prevent the *black rot*.

"In 1784 I am led to believe that the intense frost injured the potato. Latterly, people seem to be aware of the deleterious effects of frost, and denominate the potato so injured '*spuggaun*,' from its softness.

"The year 1795 was one of unusual character, both in Europe and America: the weather here was uncommonly severe, the spring cold and late, the summer suffocatingly hot, damp, and rainy, while south winds were prevalent. There was a disease among vegetables, especially potatoes and cabbages.

"In 1800 there was a partial failure of the potato, owing to excessive drought; the disease appeared in the stalks; the harvest generally was bad; great scarcity and distress succeeded. The potato also failed in England, and for some years afterwards the *curl* injured many of the best varieties there.

"1801. A very general potato failure, attributed to obstructed vegetation, while the sets were yet in the ground.

"1807. The frost, which set in about November with unusual severity, destroyed nearly one-half of the potato crop.

"In 1809 the *curl* again injured the potatoes, though not to such an extent as to deserve the name of a failure.

"1811. The spring and early summer of this year were excessively wet; a partial failure of the potato crop occurred.

"In 1812 some of the early planted potatoes failed.

"In 1816 the spring was unusually backward, the summer and autumn also very late, and the whole year characterized by far more than the average amount of rain; the potato again failed very generally throughout the kingdom. At this time the stalk was the part chiefly affected. The potato crop in England was also especially defective, which shows how wide-

spread and malignant were the peculiar atmospheric influences which characterized that period. The accounts of this epidemic in England state that, early in September, the potatoes were 'blackened and spoiled; they smell at a distance the same as after a frosty night late in October'—symptoms which indicated a similarity between the epidemic of that period and the one with which we have lately become so familiar.

"1817. This was called the year of the malty flour. The potato crop was very deficient; hence, continued scarcity during the ensuing winter.

"A great quantity of snow fell in the end of 1820, and extensive inundations followed, which produced remarkable telluric phenomena early in the following year; for instance, the 'moving bog.'

"May and June, 1821, were dry, cold, and frosty; but the autumn was one of unusual moisture: the rain accumulated upon the surface of the ground, the rivers and lakes swelled, and the floods spread far and wide over the face of the land, the rain continuing to pour in torrents during November, December, and part of the following January. The potato crop soured and rotted in the ground; and although a sufficiency was obtained in the dry and upland districts to support human life for some months, it was expended early in the ensuing spring. Fortunately, these effects were not general throughout the kingdom, but occupied a district which might be defined by a line drawn from the Bay of Donegal, upon the north side, at the junction of the counties of Sligo and Leitrim, to Youghal Harbour, where the counties of Cork and Waterford border on the south, thus including the whole western seaboard of Sligo, Mayo, Galway, Clare, Limerick, Kerry, and Cork; all exposed to the full force of the Atlantic, the influence of which, though mild, is moist.

"In 1825 the seasons were mild, yet we read of a partial failure of the potato crop, as may be instanced by the rise in the price of potatoes.

"The year 1829 was wet, and the month of August particularly so; the crops were beaten down by the heavy rains and severe storms, and in all the low grounds the water overran the potatoes, and so remained for many weeks; thus a great quantity of the potatoes were lost this year also.

"In 1830 violent storms and heavy rains brought upon the west of Ireland another failure of the potato, with its usual accompaniment of famine and pestilence: but it was principally confined to the coasts of Mayo, Galway, and Donegal. This blight was common to parts of America and to Germany, where it continued for two years.

"In 1832, and for several years following in succession, an unmistakable epidemic attacked the potato in spring throughout Ireland, and also extended to other parts of Europe and to America.

"In 1833 the potato disease presented not only the appearance of the *curl*, but likewise attacked the tubers in the pits.

"In 1834 the failure was chiefly observed in the early-planted potatoes, but having been discovered in spring, was, to a certain extent, remedied.

"Although there was an intermission in 1835, a partial failure of the potato was observed in several parts of Ireland in 1836, which had been wet, and July and August unusually so; the price of food rose to an almost unparalleled height.

"I have not found any account of a special failure of the potato crop in the wet year of 1838, but the 'inherent constitutional weakness' of that esculent was observed, and the deterioration in the best kinds formed the theme of public remark at the time.

"In 1839 there was an unmistakable failure of that crop, attributed to the incessant rains, and the extensive inundations; in New England, in this year, the *black rust* 'struck [the potato] universally on the 27th of August.'

"The year 1839 was distinguished by an amount of mois-

ture unparalleled, according to modern observations; and part of 1840 was likewise characterized by excessive moisture; although there was less rain than in the previous year, yet it came down at an unpropitious period; the potato crop failed again in Leinster and Munster; and upon both occasions great distress followed. The Scotch islands of Arran and the Highlands are said to have suffered from partial potato failures yearly, from 1839 to 1842 inclusive. In 1840 the potato disease prevailed to such a degree in Germany as to threaten the total extinction of that esculent; and in the following year the crop was extensively affected there with a disease called '*dry gangrene*.'

"In 1841 excessive rains occurred in August, causing a partial destruction of crops, especially in the south of Ireland; the year was cold and frosty, and although not specially characterized for its wetness, the number of days upon which rain fell was very great.

"In 1842, which was more than usually unfavourable to vegetation, although the harvest generally was good, the potato crop was injured by the inundations.

"1843 was more fatal to animal than vegetable life in Ireland; but in other countries, and especially in North America, the potato suffered severely from the *dry rot*—evidently the commencement of that great *blight* which prevailed so generally during the ensuing five or six years.

"In 1844, the severity of the seasons again acting prejudicially upon vegetable life, there was a partial failure of the potato, and destitution again followed in its wake. The failures were noted early in spring, shortly after the seed was planted; and even in June, the first symptoms of that vegetable pestilence, which laid the foundation of the late misery, appeared. Although the crop was reported generally a good one, acute observers remarked what was then termed the degeneracy of the tubers, and prognosticated that the future crop would either fail entirely when any additional

predisposing causes ensued, or would send up a puny and diseased stalk. In America, also, although the weather was dry, the potato crop was defective, having suffered from *blight;* symptoms of the disease likewise appeared, late in the autumn of this year, in England, especially in Kent and Devonshire.

"1845. General potato failure. The disease, which had already manifested itself in North America, first appeared generally in Great Britain and Ireland late in the autumn of this year; it also extended throughout Scotland, and was very destructive in Holland, Belgium, France, and Germany.

"1846. Complete and general potato failure throughout all Ireland.

"1847. Very extensive potato failure. Turnips and other green crops were also injured. There was a failure in the beans similar to that in the potato.

"1848. Extensive potato failure. At the end of July and beginning of August the usual blight was again reported, but not so general as in 1846.

"1849. Potato failures reported from various parts of the country.

"1850. The potato blight appeared in some localities, but to a partial extent only.

"1851. Slight and partial potato failure.

"Partial and localized failures were reported during the summers and autumns of 1852, 1853, and 1854.

"Thus we find that partially in 1845, almost entirely in 1846, very extensively in 1847, and nearly as much so in 1848, the potato, as a crop, failed; and as the disease rose, so it sunk, for in 1849 and 1850, potato failures, although not general, were both intense and widely extended. Like the invasion of other great epidemics affecting man or animals, the violence of which approaches a culminating point and then abates, so the late potato disease slowly and insidiously progressed, until it reached its acme, during 1846, 1847, 1848, then stood still, and gradually, year by year, gave way, until the

severe frost of 1855 appeared to have so far altered the conditions of the atmosphere, that this esculent again assumed a healthy character, and regained its natural flavour.

"Even yet we read that, in the Cahirciveen Union, 'last season, there was a more extensive and destructive failure of the potato crop than was experienced there for the previous seven years; and the consequence was that, from the 1st of August up to the present date, no less than £29,000 worth of Indian corn and meal was landed on Cahirciveen quay for home consumption.'—*Kerry Evening Post.* This blight was, however, very local.

"In enumerating the food of the Irish, Petty mentioned 'butter made rancid by keeping in bogs;' and in the Irish Hudibras we read of—

—— 'Butter to eat with their hog,
Was seven years buried in a bog.'

"When I originally read the statement of Petty, I came to the conclusion that he was wrong, and that this bog butter was much older than his time, but I have learned to correct that opinion. Why or wherefore the people put their butter in bogs I cannot tell, but it is a fact that great quantities of this substance have been found in the bogs, and that it has invariably assumed the physical and chemical characters presented by the specimen now before the Academy. It is converted into a hard, yellowish-white substance, like old Stilton cheese, and in taste resembling spermaceti; it is, in fact, changed into the animal substance denominated *adipocere.* Two questions arise, at what time the Irish ceased to bury butter, and how long it would take to produce this change in it.

"From the 'Mechanics' Magazine,' for September, 1824, we learn that this substance, there styled 'mineral tallow,'

was first discovered in Finland in 1736. About the year 1820, a quantity of it, then called 'mountain tallow,' was discovered on the borders of Loch Fyne, in Scotland, and was described in the 'Edinburgh Philosophical Journal,' vol. xi.

"In 1817, a mass of this bog butter or tallow, weighing about 23 lbs., was discovered in a bog on the Galtee Mountains. In June, 1826, a tub, containing about 21 lbs. weight of this substance, was found in a bog near Ballinasloe; it was presented to the Royal Dublin Society by Lord Dunlo, and was described by Professor Edmund Davy in the Proceedings of that body. Since then, very many specimens of this substance have been found; we possess three or four very fine samples in the Museum of the Academy; and other collections, both public and private, contain several examples. It is almost always found in wood, either in vessels cut out of a single piece, like large *methers*, or in long firkins, of which there is a good example in the Museum. So far as I can gather, the bog butter is always found at a great depth, ten or twelve feet, at least, in old, solid bogs. Whether the vessels were originally buried at that depth; whether they were placed nearer the surface, and in lapse of years sunk; or whether the bogs have grown over them, are questions I cannot determine. How many years it would take to produce in tallow, suet, or butter, the remarkable change exhibited by all the specimens which have been discovered, is a question of much interest; in connexion with which I may state the curious fact lately mentioned to me, that when the common fosses of Paris, into which a great number of bodies had been thrown in 1793, were opened a few years ago, it was found that the substance into which they had been converted was an *adipocere* somewhat resembling this bog butter.

"In the 'Edinburgh Philosophical Journal,' to which I have alluded, will be found the first analysis of this substance that I am aware of. Professor E. Davy made a very careful examination of it in 1826, the results of which are published

in the Proceedings of the Royal Dublin Society for that year; I understand that a German, named Luck, published another analysis of it about ten years ago; and I have recently received the following communication from Mr. Sullivan, of the Museum of Irish Industry, who has paid much attention to thesubject;—

"'I have obtained from every specimen which I examined more or less of all the peculiar oily acids of butter, which renders it more than probable that they were all originally butter. I may, however, observe, that the finding of these would not amount to absolute proof as to the substance being butter, as I have obtained butyric acid by the slow decomposition of flour under water; also from brain and meat, with fatty tissues attached; and we also know that all these acids can be produced by the oxidation of fats generally. One of the reasons which led me to think that they were originally butter is, that scarcely any of the other volatile acids of the series, produced by the oxidation of fats, besides those obtained directly from butter, are usually present in bog butter. I never detected the presence of salt in any of the specimens which I examined, at least not in any quantity to warrant the supposition that if it had been butter it was salted. In connexion with this result, which otherwise would be a great objection to the idea of its having been originally butter, it is well to bear in mind that butter is even now made in Cork and in the town of Antrim without salt.'

"Two circumstances may have influenced those who buried this butter: it was done either for the purpose of security, or in order to produce that very change in it which Petty calls rancid. In Classin and Povelson's 'Travels in Iceland,' we read that the peasantry and poor people eat in winter what is called sour butter, which is preserved without salt; and although it becomes in time acid, it may be preserved for more than twenty years. In former times there were public magazines attached to each bishop's see, in which great quantities of

this acid butter were stored up against years of scarcity; but we read, 'when the sour butter is too old, it loses in its acidity and weight, dries up, and acquires a *rancid* taste.' The most remarkable reference to the substance under consideration, and one that serves to throw most light upon the subject, is that contained in Debe's Description of the Faroe Isles in 1670; it is there called (according to the English translation) preserved tallow and 'Rue tallow,' and was thus treated: the tallow, principally obtained from sheep, was cut in pieces, and allowed to rot awhile; it was then rendered, and cast into large pieces, which 'they dig and put in moist earth to keep it, it growing the better the longer it is kept, and when it is old and is cut, it tasteth like old cheese. The most able peasants have ever much endeavoured to bring together a great quantity of that tallow, so that a countryman had sometimes in the tallow dike (that is, a place in the earth where it is kept) above 100 loads, and this hath always been looked upon as the greatest riches of Feroe. For when sheep dye, such tallow is very necessary in the land, the longer it is kept being so much the better; and forreign pyrates having little desire to rob it from them. It may, therefore, not unreasonably be termed a hidden treasure, which rust doth not consume, nor thieves steal away.' "*

Mr. David Moore and Dr. Aldridge made some remarks.

Rev. J. H. Jellett read a Paper on the effect of the internal fluidity of the earth on the length of the day.

The researches of Mr. Hopkins have shown that the effect of the action of the sun and moon upon the spheroidal figure

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* "Fœroæ, et Fœroa Reserata; that is, a Description of the Islands and Inhabitants of Foeroe. Written in Danish, by Lucas Jacobson Debes, M. A., and Provost of the Churches there. Englished by John Sterpin, Doctor of Physic." London, 1676.

of the earth, is to cause a separation between the axis of rota tion of the external shell, and the axis of rotation of the internal fluid.

The effect of such a separation will plainly be to develop a force of friction between the fluid and the shell. It becomes, then, a question of considerable importance to ascertain whether this friction, which of course exercises a retarding force upon the velocity of rotation, produces any appreciable effect upon the length of the day.

For very small relative velocities, as in the present case, the force of friction may be taken to be proportional to the velocity. If, then, ω represent the velocity of rotation of the earth, y the distance of any point on the inner surface of the shell from the axis of rotation of the shell, and α the angle between this axis and the axis of rotation of the fluid, it is easy to see that the moment of the friction round the axis of rotation will be

$$k\omega\,(1 - \cos\alpha)\int y^2 dS,$$

k being a constant depending upon the nature of the fluid, and dS the element of the surface. Assuming the shell to be spherical, which is very nearly true, and extending the integral through the entire surface, this becomes

$$\frac{8\pi k\omega}{3}\,a^4\,(1 - \cos\alpha),$$

a being the internal radius of the shell. The equation of rotation of the shell will be, therefore,

$$Mk'^2\,\frac{d\omega}{dt} = -\,\frac{8\pi k a\omega^4}{3}\,(1 - \cos\alpha),$$

Mk'^2 being the moment of inertia of the shell.

The author then proceeds to perform the calculation, on the supposition that the earth is filled with a fluid, whose force of friction is such that it would in $1'$ reduce to its $\frac{1}{100}$th part, the velocity of a sphere composed of a material similar to that

of the earth's crust, and whose diameter is one foot. Even with a fluid nucleus exercising so powerful a friction as this, he finds that for a thickness of shell = 20 miles, the increase in the length of the day in 3000 years would be less than

$$0''.01.$$

In fact, the increment would be much less than this; for this calculation is made upon the supposition, that the separation between the arcs has at all times its maximum value; and that this value is that which it would have if no friction existed. The real separation, is, of course, much less than this.

If the crust of the earth had a thickness of 1000 miles, the increment would probably be less than

$$0''.0001.$$

For a particular thickness of crust, determined by Mr. Hopkins to be about 800 miles, the foregoing reasoning ceases to be applicable, and the separation might attain a much greater value; but, with our present imperfect knowledge of the laws of motion of viscous fluids, it seems impossible to give a complete solution of the question.

Mr. Hennessy, the Rev. Samuel Haughton, and Mr. Jukes, made some remarks on Mr. Jellett's Paper.

The President called the attention of the Academy to the fact that the Council had authorized the late President, Rev. Dr. Robinson, and the Rev. Dr. Lloyd, on their part, to join the University of Dublin, and other institutions in this city, in an invitation to the British Association for the Advancement of Science, to hold their annual meeting for 1857 in Dublin; whereupon—

It was resolved,—That the Academy do highly approve of the action of the Council in this matter, and request the President to convey to the permanent officers of the British Association their complete concurrence in the invitation.

MONDAY, JUNE 9TH, 1856.

JAMES HENTHORN TODD, D. D., PRESIDENT, in the Chair.

DOMINICK M'CAUSLAND, Robert M'Dermott, M. B., Rev. James M'Ivor, and Sir Colman M. O'Loghlen, Bart., were elected Members of the Academy.

Rev. Charles Graves, D. D., read a letter from Dr. Boole, on the solution of the equation of continuity of an incompressible fluid.

"*Queen's College, Cork,*
"*5th May*, 1856.

"MY DEAR GRAVES,—Your memoirs on the application of the method of Quaternions to the solution of the partial differential equation,

$$\frac{d^2u}{dx^2} + \frac{d^2u}{dy^2} + \frac{d^2u}{dz^2} = 0,$$

have called to my mind some researches upon which I was engaged many years ago, and which establish what I conceive to be the general theory of such applications, and throw some light upon the question of the probable value of the results obtained. I will communicate to you the fundamental theorem to which my investigations led, and explain its application to the particular case which you consider. But I wish you to understand that this application was not contemplated by me at the time the theorem was discovered.

"First, however, I will observe that your method expressly consists in interpreting the forms

$$e^{-x(jD_2+kD_3)}f_1(y, z), \quad e^{x(jD_2+kD_3)}f_2(y, z),$$

where D_2 stands for $\frac{d}{dy}$, and D_3 for $\frac{d}{dz}$,—forms originally suggested by Mr. Carmichael, but by him erroneously inter-

preted. The compound symbols which operate upon the arbitrary functions $f_1(y, z)$, $f_2(y, z)$, are both functions of the symbol $jxD_2 + kxD_3$, which is, in fact, a special form of a quaternion. It is what the quaternion $p + qi + rj + sk$ becomes if we make $p = 0$, $q = 0$, $r = xD_2$, $s = xD_3$, assumptions which do not violate any of the formal conditions to which quaternions are subject. For the symbols xD_2, xD_3 combine with each other like constant *quantities*.

"It appears to me, therefore, that the operating symbols being functions of symbolical quaternions, the most natural method of seeking their interpretation is to refer them to the more general problem of the development of a function of a quaternion. This development constitutes the object of the fundamental theorem to which I have referred. It is contained in the following

PROPOSITION.

"To develop $f(w + ix + jy + kz)$ in the form of a simple quaternion, i. e. in the form $W + iX + jY + kZ$, where W, X, Y, Z are functions of w, x, y, z; it being given that $f(w)$ is capable of being developed in ascending powers of w by Maclaurin's theorem.

"Since $f(w)$ is capable of being expressed in a series of the form $A + Bw + Cw^2 + Dw^3 + \&c.$, it is evident that if we represent the quaternion $w + ix + jy + kz$ by Q, the function $f(Q)$ will be capable of expansion in the corresponding series $A + BQ + CQ^2 + DQ^3 + \&c.$ (1), for Q combines with symbols of quantity just as if it were itself a symbol of quantity. We might indeed consider $f(Q)$ as intelligible only by means of its development in a series of integral powers of Q. Thus we might take as the very *definition* of e^Q that it represents the series $1 + Q + \frac{1}{1.2}Q^2 + \frac{1}{1.2.3}Q^3 + \&c.$ It is only by reference to such a series that we can see how a function of a quaternion such as e^Q can be reduced to a simple quaternion. For the several powers Q^2, Q^3, &c. assume by actual involu-

tion the forms of simple quaternions, and their substitution in the series reduces it to a quaternion also, the coefficients W, X, Y, Z being expressed by infinite series.

"From the form of $f(Q)$, as expressed in (1), it is evident that we shall have $Qf(Q) = f(Q)\,Q$. Now substituting for Q and $f(Q)$ their values, viz.

$$\left.\begin{aligned} Q &= w + ix + jy + kz \\ f(Q) &= W + iX + jY + kZ \end{aligned}\right\} \qquad (2)$$

we have

$$(w + ix + jy + kz)(W + iX + jY + kZ)$$
$$= (W + iX + jY + kZ)(w + ix + jy + kz) \qquad (3)$$

an equation which, it is to be observed, would not be true unless the quaternions $w + ix + jy + kz$ and $W + iX + jY + kz$ were functionally related. Multiplying out, and attending to the rules of quaternions, we have from (3)

$$w^2 - xX - yY - zZ + i(wX + Wx + yZ - Yz) + j(wY + Wy + zX - Zx) + k(wZ + Wz + xY - Xy) = w^2 - Xx - Yy - Zz + i(Wx + Xw + Yz - yZ) + j(Wy + wY + Zx - zX) + k(Wz + wZ + Xy - xY).$$

Equating coefficients, we find

$$yZ - Yz = 0, \quad zX - Zx = 0, \quad xY - Xy = 0,$$

or

$$\frac{X}{x} = \frac{Y}{y} = \frac{Z}{z} = V, \text{ suppose.}$$

We are therefore permitted to assume

$$f(w + ix + jy + kz) = W + V(ix + jy + kz) \qquad (4)$$

and it remains to determine W and V.

"Now $f(Q)$ being by hypothesis of the form $\Sigma A_n Q^n$, let us seek the special forms of W and V for the particular case in which $f(Q) = Q^n$.

"In virtue of (4) we may then write

$$Q^n = W_n + V_n(ix + jy + kz), \qquad (5)$$

whence

$$Q^{n+1} = W_{n+1} + V_{n+1}(ix + jy + kz). \qquad (6)$$

Now multiplying both sides of (5) by Q, or $w + ix + jy + kz$, we have

$$Q^{n+1} = wW_n - V_n(x^2 + y^2 + z^2) + (wV_n + W_n)(ix + jy + kz).$$

Comparing this with (6), we have

$$\left.\begin{aligned} W_{n+1} &= wW_n - r^2 V_n \\ V_{n+1} &= wV_n \;\; + W_n \end{aligned}\right\} \text{ where } r^2 = x^2 + y^2 + z^2,$$

a pair of simultaneous equations of finite differences. From these we readily deduce

$$\begin{aligned} W_{n+2} - 2wW_{n+1} + (w^2 + r^2)W_n &= 0, \\ V_{n+2} - 2wV_{n+1} + (w^2 + r^2)V_n &= 0. \end{aligned}$$

The complete integrals of which are

$$W_n = c(w + r\sqrt{-1})^n + c'(w - r\sqrt{-1})^n, \tag{7}$$

$$V_n = b(w + r\sqrt{-1})^n + b'(w - r\sqrt{-1})^n. \tag{8}$$

c, c', b, b', being arbitrary constants.

"To determine the values of these constants let $n = 0$; whence from (5) it is evident that $W_0 = w$, $V_0 = 0$; values which, substituted in (7) and (8), give

$$1 = c + c',$$
$$0 = b + b'.$$

"Again, let $n = 1$, whence substituting in (5) for Q its value $w + ix + jy + kz$, we find $W_1 = w$, $V_1 = 1$, and employing these values in (7) and (8), we have

$$w = c(w + r\sqrt{-1}) + c'(w - r\sqrt{-1}),$$
$$1 = b(w + r\sqrt{-1}) + b'(w - r\sqrt{-1}).$$

From these four equations, we find

$$c = \frac{1}{2}, \quad c' = -\frac{1}{2}, \quad b = \frac{1}{2r\sqrt{-1}}, \quad b' = \frac{-1}{2r\sqrt{-1}}.$$

Substituting these values in (7) and (8), and the resulting values of W_n and V_n in (5), we have

$$Q^n = \frac{(w + r\sqrt{-1})^n + (w - r\sqrt{-1})^n}{2}$$
$$+ \frac{(w + r\sqrt{-1})^n + (w - r\sqrt{-1})^n}{2r\sqrt{-1}}(ix + jy + kz). \tag{9}$$

Multiply both members of this equation by A_n, and attach the symbol Σ. Then since

$$\Sigma A_n Q^n = f(Q) = f(w + ix + jy + kz)$$
$$\Sigma A_n (w + r\sqrt{-1})^n = f(w + r\sqrt{-1})$$
$$\Sigma A_n (w - r\sqrt{-1})^n = f(w - r\sqrt{-1})$$

we have

$$f(w + ix + jy + kz) = \frac{f(w + r\sqrt{-1}) + f(w - r\sqrt{-1})}{2}$$
$$+ \frac{f(w + r\sqrt{-1}) - f(w - r\sqrt{-1})}{2r\sqrt{-1}} (ix + jy + kz) \quad \text{(I.)}$$

the development required.

PARTICULAR DEDUCTIONS.

"There are two particular cases of the above theorem which deserve special notice.

"The first is when $f(Q) = Q^n$. The expression given in (9) may then be reduced to the following form:

$$(w + ix + jy + kz)^n = (w^2 + r^2)^{\frac{n}{2}} \left(\cos n\theta + \frac{\sin n\theta}{r} (ix + jy + kz)\right)$$

where $\theta = \tan^{-1} \frac{r}{w}$.

"If $n = -1$, this gives

$$(w + ix + jy + kz)^{-1} = (w^2 + r^2)^{-1} (w - ix - jy - kz),$$

a well-known theorem.

The second case is when $f(Q) = e^Q$. Here we have

$$e^{w+ix+jy+kz} = \frac{e^{w+r\sqrt{-1}} + e^{w-r\sqrt{-1}}}{2} + \frac{e^{w+r\sqrt{-1}} - e^{w-r\sqrt{-1}}}{2r\sqrt{-1}} (ix + jy + kz)$$
$$= e^w \cos r + e^w \frac{\sin r}{r} (ix + jy + kz)$$

$$\therefore\ e^{w+ix+jy+kz} = e^w \left[\cos r + \frac{\sin r}{r} (ix + jy + kz)\right] \quad \text{(II.)}$$

where, as before, $r = \sqrt{(x^2 + y^2 + z^2)}$.

"*Application of the above Results to the Solution of the Equation* $\frac{d^2u}{dx^2}+\frac{d^2u}{dy^2}+\frac{d^2u}{dz^2}=0$:—

"Writing this equation in the form

$$\left(\frac{d^2}{dx^2}+\frac{d^2}{dy^2}+\frac{d^2}{dz^2}\right)u=0,$$

we can, by the properties of quaternions, reduce it to any of the following forms,

$$\left(\frac{d}{dx}+i\frac{d}{dy}+j\frac{d}{dz}\right)\left(\frac{d}{dx}-i\frac{d}{dy}-j\frac{d}{dz}\right)u=0,$$

$$\left(\frac{d}{dx}+j\frac{d}{dy}+k\frac{d}{dz}\right)\left(\frac{d}{dx}-j\frac{d}{dy}-k\frac{d}{dz}\right)u=0,$$

$$\left(\frac{d}{dx}+k\frac{d}{dy}+i\frac{d}{dz}\right)\left(\frac{d}{dx}-k\frac{d}{dy}-i\frac{d}{dz}\right)u=0.$$

You employ the second of these, which leads to the solution

$$u=e^{x\left(j\frac{d}{dy}+k\frac{d}{dz}\right)}f_1(y,z)+e^{-x\left(j\frac{d}{dy}+k\frac{d}{dz}\right)}f_2(y,z),$$

the symbolical form adopted by Mr. Carmichael and yourself.

"Now the development of the first operating symbol will be obtained from (II.) by changing therein w and x to 0, y to $x\frac{d}{dy}$, and z to $x\frac{d}{dz}$: whence $r=x\sqrt{\left\{\left(\frac{d}{dy}\right)^2+\left(\frac{d}{dz}\right)^2\right\}}$.

"We thus find

$$e^{x\left(j\frac{d}{dy}+k\frac{d}{dz}\right)}=\cos\left\{x\left(\frac{d^2}{dx^2}+\frac{d^2}{dy^2}\right)^{\frac{1}{2}}\right\}+\frac{\sin\left\{x\left(\frac{d^2}{dx^2}+\frac{d^2}{dy^2}\right)^{\frac{1}{2}}\right\}}{x\left(\frac{d^2}{dx^2}+\frac{d^2}{dy^2}\right)^{\frac{1}{2}}}$$

$$\times\left(xj\frac{d}{dy}+xk\frac{d}{dz}\right).$$

The development of $e^{-x\left(j\frac{d}{dy}+k\frac{d}{dz}\right)}$ will be obtained from the above by merely changing x into $-x$.

" If, for simplicity, we represent the expression $\frac{d^2}{dx^2} + \frac{d^2}{dy^2}$ by Δ, we find for u the values

$$u = \cos(x\Delta^{\frac{1}{2}}) f_1(y, z) + \sin(x\Delta^{\frac{1}{2}})\, \Delta^{-\frac{1}{2}} \left\{ \frac{jdf_1(y, z)}{dy} + \frac{kdf_1(y, z)}{dz} \right\}$$

$$+ \cos(x\Delta^{\frac{1}{2}}) f_2(y, z) - \sin(x\Delta^{\frac{1}{2}})\, \Delta^{-\frac{1}{2}} \left\{ \frac{jdf_2(y, z)}{dy} + \frac{kdf_2(y, z)}{dz} \right\}$$

and if we assume

$$f_1(y, z) + f_2(y, z) = \phi_1$$
$$f_1(y, z) - f_2(y, z) = \phi_2$$

we find for the general value of u the expression

$$u = \cos(x\Delta^{\frac{1}{2}})\, \phi_1 + \sin(x\Delta^{\frac{1}{2}})\, \Delta^{-\frac{1}{2}} \left\{ \frac{jd\phi_2}{dy} + \frac{kd\phi_2}{dz} \right\} \qquad \text{(III.)}$$

ϕ_1 and ϕ_2 being arbitrary functions of y and z.

" This solution agrees substantially with the one which you have obtained. If we develop the cosine and the sine, each of the operating functions will assume the form of a series expressed in ascending integral powers of Δ, i. e., of $\frac{d^2}{dy^2} + \frac{d^2}{dz^2}$, and the operation can then be performed when ϕ_1 and ϕ_2 are given. We shall, in fact, have

$$u = F_1 + jF_2 + kF_3, \text{ where}$$

$$F_1 = \phi_1 - \frac{x^2}{1.2}\left(\frac{d^2\phi_1}{dy^2} + \frac{d^2\phi_1}{dz^2}\right) + \frac{x^4}{1.2.3.4}\left(\frac{d^4\phi_1}{dx^4} + 2\frac{d^4\phi_1}{dx^2dy^2} + \frac{d^4\phi_1}{dy^4}\right) - \&c.$$

$$F_2 = x\frac{d\phi_2}{dy} - \frac{x^3}{1.2.3}\left(\frac{d^3\phi_2}{dy^3} + \frac{d^3\phi_2}{dydz^2}\right) + \&c.$$

$$F_3 = x\frac{d\phi_2}{dz} - \frac{x^3}{1.2.3}\left(\frac{d^3\phi_2}{dz^3} + \frac{d^3\phi_2}{dy^2dz}\right) + \&c.$$

results agreeing with those which you have given in your paper of April 9th, 1855.

" Instead of deducing these results directly from the symbolical forms to which the above analysis leads, your investigations conduct you to a process which consists in substituting

in the arbitrary functions ϕ_1, ϕ_2, the expressions $y + jx$, $z + kx$ for y and z respectively, developing the results in ascending powers of x by Taylor's theorem, and then substituting, according to a certain directive canon, 'mean products' of j and k for ordinary products. I think it a remarkable circumstance that it should be possible thus to obtain the true developed values of F_1, F_2, F_3, and the theorem upon which the process is founded is well worthy of being recorded. But I cannot agree with you that it can be considered as virtually freeing your solution, viewed with reference to the determination of F_1, F_2, F_3, from imaginary quantities. For in any parallel case in which imaginary quantities are involved in an algebraic expression, we can, formally at least, get rid of them by substituting for the given expression some other expression not involving those quantities, with the provision that *after* development certain changes, governed by a particular rule or canon, shall be made. The function $\cos x$, for example, considered analytically, involves imaginary quantities, for it is expressed in finite terms by the formula $\dfrac{e^{x\sqrt{-1}} + e^{-x\sqrt{-1}}}{2}$. Now I apprehend that we should not virtually escape from this condition of its finite expression, by presenting the function under the form $\dfrac{e^{x} + e^{-x}}{2}$, and adding, as a direction, that in the development of this function the signs of the alternate terms should be changed.

"When among the physical conditions of a problem dependent upon the differential equation

$$\frac{d^2u}{dx^2} + \frac{d^2u}{dy^2} + \frac{d^2u}{dz^2} = 0,$$

symmetry, with reference to an axis, as that of x, is involved, a particular integral of the equation may be presented in the form $u = \int_0^\pi d\theta \phi (x + r \cos\theta \sqrt{-1})$, wherein $r = \sqrt{(y^2 + z^2)}$. This integral was given first, so far as I am aware, by myself

in the 'Cambridge and Dublin Mathematical Journal,' Jan. 1847, and was shown to represent the most complete solution of the equation, with reference to the problem of the attraction of a solid of revolution on an external point.* See also a memoir by Hoppe, on the problem of the motion of conoidal bodies through an incompressible fluid ('London Quarterly Journal of Mathematical Science,' No. IV.). In its general form, i.e. antecedently to the determination of the function ϕ, this integral cannot be freed from imaginary quantities without development. When, however, the function ϕ is known, it may be freed from them without development. It appears to me, therefore, that the solution possesses, in respect of its relation to imaginary quantities, an advantage over the form which you have deduced by the method of quaternions.

"The direct symbolical solution of the equation,

$$\frac{d^2u}{dx^2} + \frac{d^2u}{dy^2} + \frac{d^2u}{dz^2} = 0,$$

obtained by resolving the operating symbol into factors of the form $\frac{d}{dx} + \left(\frac{d^2}{dy^2} + \frac{d^2}{dz^2}\right)^{\frac{1}{2}}\sqrt{-1}$, and $\frac{d}{dx} - \left(\frac{d^2}{dy^2} + \frac{d^2}{dz^2}\right)^{\frac{1}{2}}\sqrt{-1}$, is

$$u = \cos\left\{x\left(\frac{d^2}{dy^2} + \frac{d^2}{dz^2}\right)^{\frac{1}{2}}\right\} f_1(y, z) + \sin\left\{x\left(\frac{d^2}{dy^2} + \frac{d^2}{dz^2}\right)^{\frac{1}{2}}\right\} f_2(y, z).$$

If, in consequence of the arbitrary form of the functions $f_1(y, z)$, $f_2(y, z)$, we replace the latter function by

$$\left(\frac{d}{dy^2} + \frac{d^2}{dz^2}\right)^{-\frac{1}{2}} \phi_2(y, z),$$

wherein $\phi_2(y, z)$ denotes also an arbitrary function of y and z, and then for symmetry write ϕ_1 for f_1, we have

$$u = \cos\left\{x\left(\frac{d^2}{dy^2} + \frac{d^2}{dz^2}\right)^{\frac{1}{2}}\right\} \phi_1(y, z) + \sin\left\{x\left(\frac{d^2}{dy^2} + \frac{d^2}{dz^2}\right)^{\frac{1}{2}}\right\}$$
$$\left(\frac{d^2}{dy^2} + \frac{d^2}{dz^2}\right) \phi_2(y, z),$$

* I have since obtained, in the form of a double integral, the complete solution of the equation under the condition referred to.

a solution which becomes interpretable by developing the circular functions.

"Now in what respect does this solution differ from the one furnished by the quaternion method, (III.)? Merely in this, that the arbitrary function $\phi_2(y, z)$ in the one, is replaced by the arbitrary quaternion function $\left(j\frac{d}{dy} + k\frac{d}{dz}\right)\phi_2(y, z)$ in the other. Practically, then, the employment of quaternions in the resolution of the factor $\frac{d^2}{dx^2} + \frac{d^2}{dy^2} + \frac{d^2}{dz^2}$ merely leads to the substitution of an arbitrary function involving quaternion coefficients for an arbitrary function of the ordinary species. Might we not, then, if there be any advantage in the result, introduce the change at once? If $\phi(y, z)$ be an arbitrary function involved in the solution of a linear equation, it is evident that we may satisfy the equation by replacing that arbitrary function by any other of the form $\Sigma i\phi(y, z)$, i being susceptible of any system of constant values, real or imaginary. It is seen that the quaternion analysis employed from the beginning leads equally to the forms

$$\left(i\frac{d}{dy} + j\frac{d}{dz}\right)\phi_2(y, z) \text{ and } \left(k\frac{d}{dy} + i\frac{d}{dz}\right)\phi_2(y, z),$$

as to the form

$$\left(j\frac{d}{dy} + k\frac{d}{dz}\right)\phi_2(y, z);$$

and you correctly observe that any of the separate terms affected by distinct imaginaries equally satisfy the equation.

"I offer no apology for making these observations. I am sure that your object, like mine, is the discovery of truth alone. The application of quaternions to the solution of partial differential equations is a subject deserving of being thoroughly investigated; partly because of the analytical interest attaching to the inquiry, and partly because the possibility of resolving the function $\frac{d^2}{dx^2} + \frac{d^2}{dy^2} + \frac{d^2}{dz^2}$ into two linear factors,

seems at first sight to promise material aid in the solution of a problem of peculiar physical importance. The latter consideration appears to have been present to your own mind. I have now stated to you the reasons which have led me to entertain a different opinion.

"Believe me to be, my dear Graves,
"Yours very truly,
"George Boole.

"*The Rev. Dr. Graves.*"

Dr. Graves remarked that the general expression given by Dr. Boole for the development of a function of a quaternion, viz.:—

$$f(w+ix+jy+kz) = \tfrac{1}{2}\{f(w+r\sqrt{-1})+f(w-r\sqrt{-1})\}$$
$$+\frac{1}{2r\sqrt{-1}}\{f(w+r\sqrt{-1})=f(w-r\sqrt{-1})\}(ix+jy+kz),$$

might be obtained by a process simpler, though less interesting, than that adopted by Dr. Boole.

Putting

$$x=r\cos\alpha,\ y=r\cos\beta,\ z=r\cos\gamma,\ \cos^2\alpha+\cos^2\beta+\cos^2\gamma=1;$$

and denoting $i\cos\alpha+j\cos\beta+k\cos\gamma$ by ι; the problem is to develop $f(w+r\iota)$ in the form $W+iX+jY+kZ$.

Now, as w is commutative with r and ι, we may employ Taylor's theorem in the present instance, and thus find

$$f(w+r\iota)=f(w)+f'(w)\,r\iota-\frac{1}{1.2}f''(w)\,r^2-\&c.$$

The symbol ι being a square root of negative unity, this development will be precisely similar to what we should have obtained if we had sought that of $f(w+r\sqrt{-1})$; save only that ι stands in the place of $\sqrt{-1}$. Consequently, we have

$$f(w+r\iota)=\tfrac{1}{2}\{f(w+r\sqrt{-1})+f(w-r\sqrt{-1})\}$$
$$+\frac{\iota}{2\sqrt{-1}}\{f(w+r\sqrt{-1})-f(w-r\sqrt{-1})\},$$

in which, if we put $ix + jy + kz$ in place of r_ι, we obtain the expression given by Dr. Boole.

As regards the functions F_1, F_2, F_3, involved in the expression $F_1 + jF_2 + kF_3$, proposed by Dr. Graves as a complete solution of the equation

$$\frac{d^2V}{dx^2} + \frac{d^2V}{dy^2} + \frac{d^2V}{dz^2} = 0,$$

(p. 221), he desired it to be understood that he had not intended to claim for them such an independence upon imaginaries as Dr. Boole supposed him to assert. When developed in the form of series, they involve indeed no square roots of negative unity; but analytically they owe their origin to imaginaries of this kind.

Mr. Charles Haliday read a Paper on the Scandinavian Antiquities of Dublin.

The following letter from Mr. Francis M. Jennings was read:—

"*Gibraltar*, *May* 22, 1856.

"My dear Sir,—I have made up, ready to send either by post or private hand, an earring of silver used by the Soos men, at a place about 60 miles south of the city of Morocco. Also, a brooch of silver, such as are used by the Bedouins of Morocco at present; you will see it has been worn. The first I got out of the man's ear; the other from a trader. I keep duplicates, for fear of their being lost; they are for the Academy, if they think them worth accepting. I have got a few other things also, including a necklace; but I think the brooch is the most curious, as its resemblance is so great to the Irish ones. I also got off the *right* arm, from above the elbow, (where it is worn) what would be called a piece of ring-money

of copper. The man who wore it, and gave it to me, is a relative of the Sheikh of Wednoon, who was at Mogador when I was there, about ten days since;—that I keep until my return. I hope they may prove of interest. I have another brooch which is worn at present by the Bedouins and people of the country, and the Moors.

"Yours,

"FRANCIS M. JENNINGS."

JUNE 23RD, 1856.

JAMES HENTHORN TODD, D.D., PRESIDENT, in the Chair.

ROBERT PATTERSON, ESQ., was elected a Member of the Academy.

The President exhibited the original Captain's commission, granted in the reign of James II. to the great-grandfather of Michael Warren, Esq.

Professor Hennessy read a Paper on the influence of the earth's internal structure on the length of the day.

Having stated that changes in the distribution of the matter composing the interior of the earth will generally tend to alter its velocity of rotation, and thus vary the length of the day, the author proceeded to examine the probable nature of such changes. Laplace had already examined the effect of the cubical contraction of the globe considered as a cooling solid;* but if the earth consists of a solid shell filled with matter in a state of fluidity, the inquiry assumes a different shape. Hitherto this, as well as all other questions connected with the general structure and rotation of the earth, had been treated on the assumption that the particles of the fluid underwent no changes in their positions on assuming the solid state. In his "Researches in Terrestrial Physics,"† Mr. Hennessy had pointed out the necessity of abandoning this assumption, and he, moreover, investigated what would be the internal structure of the earth on the supposition that it consists of matter possessing a recognised property of the igneous rocks at its surface—namely, of contracting in volume

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* Mecanique Celeste, Livre XI. † Philosophical Transactions, 1851, Part II.

on passing from the fluid to the solid crystalline state. After the first formation of a solid shell, all the succeeding additions to its inner surface occurring by contraction from within outwards, the tendency of the process of solidification must be to lessen the pressure on the nucleus. If the increasing density of the nucleus towards its centre be due to pressure, it must follow that its mean density will be diminished by the removal of pressure from its surface; it will therefore tend to expand, and become more homogeneous. The moment of inertia of the earth will be thus directly increased; and, supposing the shell and nucleus to move as one mass, which appears to result from one of the following conclusions, as well as from the probable nature of the matter of which they are composed, a cause will exist for increasing the length of the day. But the changes referred to will also cause the surface of the nucleus to gradually become more oblate, and, consequently, each successive stratum of solidified matter added from it to the shell. The strata of the shell will therefore increase in oblateness from its outer to its inner surface, while those of the nucleus will still continue to decrease from its surface to its centre, although not always according to the same law. From this conclusion two others are deduced:—1. The existence of great pressure and friction at the surface of contact of the solid and fluid; for otherwise, according to a result obtained by Mr. Hopkins, the precession of the equinoxes would greatly differ from that which is observed.* 2. The moment of inertia corresponding to the earth's axis of rotation would be increased independently of the cause already mentioned, which would increase all the moments of inertia of the earth. This result had been already used by Mr. Hennessy, in the memoirs referred to, and also in a letter to Sir John Lubbock,† to prove the continued stability of the earth's axis

* Phil. Trans. 1840, p. 207; also, Phil. Trans. 1851, vol. ii., p. 546.

† Proceedings of the Royal Society, February, 1852.

during all geological epochs, as well as at the present day. He now applied it to the question under discussion, wherein it made the proposition more manifest, that the tendency of change of state of the matter composing the interior of the earth, in passing from fluidity to solidity, would be to increase the length of the day. At the same time the slow cubical contraction of the entire mass, due to its gradual loss of internal heat, would tend to accelerate the velocity of rotation, and to diminish the length of the day. Both of these opposing tendencies depend upon a common cause—the secular refrigeration of the earth. This, from the investigations of Fourier and Laplace, has been shown to be so extremely slow, that if only one of these counteracting tendencies existed alone, it would be difficult to detect its influence on the earth's rotation; but when their simultaneous opposition is taken into account, it should not excite surprise that astronomical observations have hitherto never disclosed any variation in the length of the day, and ages may possibly elapse before any such variation shall be discovered.

Mr. J. Huband Smith exhibited to the Academy a rubbing taken from the ancient cross in the market-place at Campbellton, in Kyntire, with a restoration, upon an enlarged scale, of the inscription upon it, as follows:—

HÆC ⁝ EST ⁝ CRVX ⁝ DOMINI ⁝ YVARI ⁝ M ⁝ HEACHYRNA ⁝ QVŌDAM ⁝ RECTORIS ⁝ DE ⁝ KYL ⁝ REACAN ⁝ ET ⁝ DOMINI ⁝ ANDREA ⁝ NATI ⁝ EIUS ⁝ RECTORIS ⁝ DE ⁝ KIL ⁝ COMAN ⁝ QVI ⁝ HANC ⁝ CRUCEM ⁝ FIERI ⁝ FACIEBAT ⁝

This inscription, in tolerably good preservation, is in raised characters of the fifteenth century, in low relief, and is placed about the middle of the shaft of the cross, which occupies a conspicuous position in the centre of the town. It is formed of a single stone, of dark-coloured compact limestone, about 9 feet in height; nearly 2 feet across the arms; 15 inches in

breadth, and little more than four inches in thickness. It is covered on both its sides, as well as on the edges, with elaborate patterns, chiefly foliage, and stands on a base of modern masonry, consisting of an ascent of seven steps above the level of the street.

Mr. Smith also exhibited a similar restoration of the inscription on the cross which stands upon the Quay at Inverary, which reads thus:—

HÆC : EST : CRVX : NOBILIVM : VIRORVM : VIDELICET : DONDCANI : MEICGYLLICHOMGHAN : PATRICI : FILII : EIVS : ET : MAELMORE : FILII : PATRICI : QVI : HANC : CRVCEM : FIERI : FACIEBAT :

And lastly, a restoration of the inscription on a shattered shaft of a cross, which lies within the ruined church of St. Oran, in the island of Iona, in the following words:—

HÆC : EST : CRVX : LACCLANNI : MEIC : FINGONE : ET : EIVS : FILII : IOHANNIS : ABBATIS : DE : HY : FACTA : ANNO : DOMINI : M : CCCC : LXXX : IX :

The date upon this last-mentioned cross fixes with certainty the period to which the three foregoing inscriptions, which are all cut in characters of the same form, are to be referred.

Mr. H. D. Graham, who published a small quarto volume, in 1850, with numerous lithographed illustrations of the ecclesiastical buildings and monumental remains at Iona, states that during an excursion made in Lorn (Argyleshire), he visited many burial-grounds, and found in nearly every one some stones brought from Iona.

Pennant, whose Tour in the Hebrides was made in the summer of 1772, seems to have been the person who gave currency to the story (afterwards partially adopted by Sir Walter Scott in his poem of "The Lord of the Isles"), that "360 crosses were standing in the island of Iona at the Reformation, but were immediately after almost entirely demolished by order of a Provincial Assembly held in the island;" and re-

fers, as his authority, to "A short Description of Iona, 1693. Advoc. Libr. MS."

William Sacheverell, who was Governor of the Isle of Man in 1688, was employed in that year in the attempt to recover the stores of the Florida, one of the great vessels of the Spanish Armada, which was blown up and sunk in the harbour of Tobermory in Mull. He shortly after published a little book, entitled, "An Account of his Voyage to I-Columb-kill," in a letter addressed to a friend, dated the 7th of September in that year. In this he states (at page 142), that "the Synod of Argyll ordered *sixty* crosses to be cast into the sea."

Mr. Huband Smith, who had been unable to discover at Iona the remains of more than fifteen or twenty crosses, was disposed to think that the number so stated to have been destroyed in Pennant's Tour, and Sir Walter Scott's poem, arose, perhaps, from accidental mistake of some transcriber, who, by the prefix of a single figure, added *three hundred* to the sixty spoken of by Sacheverell.

In Mr. Maclean's "Historical Account of Iona," published in 1841, he states that—"A.D. 1561. The Act of the Convention of Estates was passed at the desire of the Church, for demolishing all the abbeys of monks and friars, and for suppressing whatsoever monuments of idolatrie were remaining in the realm. In consequence of this edict," he proceeds, "ensued, as we may easily conceive, a pitiful devastation of churches and monasteries. It was at this time the mobility destroyed and carried away so many of the crosses which adorned Iona. The very sepulchres of the dead were rifled and ript up—Bibliothecs, and other volumes of the Fathers, together with the Registers of the Church, were cast into the streets, and afterwards gathered in heaps and burnt." For these statements Maclean cites "Keith, Hist. p. 503."

We may infer from the foregoing passages that it was about the close of the sixteenth century that the two first-

mentioned crosses which are now to be seen at Campbellton and Inverary were transported from Iona, and placed in the position they at present occupy.

The name Yvar, which occurs in the inscription on the cross at Campbellton, obviously of Scandinavian origin, appears to afford a curious illustration of the opinion entertained by many Scottish antiquaries, of the Norwegian descent of several of the clans in the western Highlands,—one of the most distinguished and powerful of those being Macleod of Macleod, whose chief fortress was the castle of Dunvegan, in Skye.

In the Annals of Innisfallen, at the year 853, is recorded the arrival in Ireland of the Norwegian chiefs Yvar and Sitric. Giraldus Cambrensis states that they were the brothers of Anlaf, and that by them the three cities of Limerick, Waterford, and Dublin, were built.

Pennant, speaking of the Mull of Cantyre, the promontory which lies at the southern extremity of Argyleshire, cites Torfæus for the following singular circumstance:—"When Magnus the Barefooted, King of Norway, obtained from Donald-Bane, of Scotland, the cession of the western isles, or all those places that could be surrounded in a boat, he added to them the peninsula of Cantyre by this fraud: he placed himself in the stern of a boat, held the rudder, and was drawn over this narrow track, and by this species of navigation wrested the country from his brother monarch." The narrow isthmus which joins Cantyre to South Knapdale is formed by the western and eastern lochs of Tarbat. These two salt-water lakes, or bogs, encroach so far upon the land, and the extremities come so near to each other, that there is not above a mile of land to divide them.

The President read a Paper on the ancient Missal, and its silver box, described by Dr. O'Conor in his Catalogue of

the Stowe MSS., and now the property of the Earl of Ashburnham.

He showed that what is now the bottom of the box is 300 years older than the top. The inscriptions on the bottom of the box were partially interpreted by Dr. O'Conor, but those on the top of the box were never read or explained before. The inscriptions on the bottom are as follows:—

NO. I.

bendacht de ar cech an main as a harilliuth

"The blessing of God on every
soul who deserves it"

—erroneously translated by Dr. O'Conor, "The blessing of God on every soul who contributed to this work much or little."

NO. II.

ōr do dondchad macc briain do rig herend

"A prayer for Donchadh son of
Brian, for the King of Erin."

This Donnchadh, or Donagh, was the son of the celebrated Brian Borumha, and was originally King of Munster, in conjunction with his brother Tadhg, whom he caused to be murdered A.D. 1023. He then became King of Ireland, but was expelled A.D. 1064, and went to Rome, where he died in penitence, in the monastery of St. Stephen, according to the contemporary Annals of Tighernach.

Thus it appears that this part of the box must have been made between the years 1023 and 1064.

NO. III.

✠ ocus do macc raith hu d ondchada do rig cassil

"And for Mac Raith grandson of Donchadh [Donogh] King of Cashel."

The genealogy of this Mac Raith, a descendant of the celebrated Ceallachan Caisel, is well known. He is styled by Tighernach, who appears not to have recognised his right to the throne of Munster, King of the Eoghanacht of Cashel. He died A.D. 1052.

This fact therefore still further limits the date of this side of the box to the twenty-nine years from 1023 to 1052.

NO. IV.

✠ ōr do dunchad hu taccain do muintir cluana do rigni

"A Prayer for Dunchadh O'Tagain, of the family [i. e., of the monastic society] of Cluana [Clonmacnois], who made it."

Of this Donchad, or Donogh O Tagain, we know nothing except what we learn from this inscription: that he was a monk of Clonmacnois, and that he was the artist or silversmith by whom the box was made.

These four inscriptions run round the four sides of the square which forms the bottom of the box. Two others originally ran at right angles to those sides, crossing at the centre of the square. But these have been rudely cut away, at their intersection, to make way for a crystal, set in an oval frame, of the same workmanship, and evidently of the same date as the top of the box. All that remain of these inscriptions are the following fragments :—

NO. V.

OR DO	. . . .	NAIN h
U CAT	. . . .	NDERNAD

" A Prayer for ——nain
O'Cath . . . by whom it was made."

That is, by whose instrumentality, or at whose expense, it was made. This must have been some person whose Christian name ended with the syllable "nain," and whose sirname began with "O Cat . . . ."

NO. VI.

✠ OC	. . . .	AND
HUT	. . . .	LAIG

" And for . . . . and
O'T . . . . laig."

Here we have a personage whose Christian name appears to have ended with "and," or "ann," and whose sirname began with "O'T" and ended with "laig." Dr. O'Conor has altogether failed to explain these inscriptions.

The inscriptions on the upper and lower plates of the top of the box are both mutilated, the latter half of both having been torn away.

The first of these may, however, with almost certainty be restored. It is as follows:—

NO. I.

✠ OR DO PILIB	UA CINNEIDIG
DO RIG URMU	MHAIN LAS A C

The words enclosed are all that now remain: the words

outside the enclosure are the proposed restoration. It may be translated thus:

"A prayer for Philip *O'Kennedy*,
for the King of Orm*ond by whom was c*—"

—where the words in Italics are the restoration.

NO. II.

umdaigeḋ in mindsa ⁊ do aini dam
nai ✠ domnall o tolari docorig misi

"[c]overed this ornament, and for Aini his wife. ✠ Domhnall O'Tolari [O'Tolare, or O'Tolarg] decorated me."

The first letter of the word cumdaigeḋ, covered, is omitted, and was probably given at the end of No. I., as represented in the above conjectural restoration.

Dr. O'Conor entirely failed to interpret these inscriptions; but Philip O'Cinneidigh (or O'Kennedy) and Aine his wife are historical personages, whose death is recorded by the Four Masters, A. D. 1381. Of the artist, Donnell O'Tolari, nothing is known. The name O'Tolari is not found in our Annals or Genealogies; and although it seems to be plainly O'Tolari in the inscription, yet it is probable that O'Tolarc, or O'Tolarg, must have been intended.

The next inscription, No. III., is so mutilated that it cannot be interpreted.

NO. IV.

✠ OR do gillaruadan umacan
don comarba las ar cumdaigead

"A prayer for Gillaruadan O'Macan,
the Comharb, by whom this was covered"

—i. e., by whose means, or at whose expense, it was covered.

No mention of this Gillaruadan O'Macan occurs in the Annals. He was probably comharb or successor of St. Ruadhan of Lorrha, in Lower Ormond, the principal church of O'Kennedy's country.

Thus it appears that there is a difference of date of about 300 years between the top and bottom of this most interesting box; the bottom having been made before the year 1052, and the top shortly before 1381.

The President then proceeded to give a description of the MS. contained in this box, which contains a copy of the Gospel of St. John, in a handwriting of the seventh century, the writer of which gives his name in Ogham characters, at the end of the Gospel, in these words:—

"Deo gratias ago, Amen. Fint, Amen. Rogo quicunque hunc librum legeris, ut memineris mei peccatoris scriptoris, .i.  peregrinus. Amen."

The Ogham characters are interpreted SONID,—a name which is certainly not Irish; and as the writer styles himself *peregrinus*, it is probable that he may have been one of those foreign students who at that time flocked to Ireland in great numbers for ecclesiastical education.

The MS. also contains a Missal, of great antiquity, the contents of which the President described in detail, showing that the more ancient portion of it may probably be as old as the fifth or beginning of the sixth century, but that it had received mutilation, by additions and alterations made about the ninth or tenth century, in order to bring the more ancient *Ordo* into conformity with the ritual of that period.

Monday, November 10th, 1856.

JAMES HENTHORN TODD, D. D., President, in the Chair.

W. R. Wilde, Esq., read an account of a MS. of Dr. Willoughby's, written in 1690, "On the Climate and Diseases of Ireland."

"Doctor Charles Willoughby was a physician, practising in Dublin towards the end of the seventeenth century. Of his family history we at present know nothing; but it is not unlikely that he was connected with Willoughby, the celebrated ornithologist. The name is English, but from such expressions in the following manuscript as 'my country,' and 'my countrymen,' the author appears to have been born in Ireland. That he must have been a man of considerable scientific attainments, as well as high professional standing, may be inferred from the fact that upon the establishment of the Dublin Philosophical Society in 1683–4,—the prototype of the Royal Irish Academy,—he was chosen its first Director, the office of President not having been then instituted.

"Of that Society I gave an account to the Academy more than twelve years ago, and a more detailed description of it will be found in my preface to the first volume of the 'Dublin Quarterly Journal of Medical Science,' published in February, 1846. Dr. Huntingdon, the Provost of Trinity College, Dublin, writing to Dr. Plot, of the Royal Society, in 1683, says: 'I don't give you the names of our Society, because you know few of them, except the Bishop of Ferns and Leighlin, Sir William Petty and Dr. Willoughby.' To these gentlemen, along with William Molyneux, who afterwards became their Secretary, were entrusted the regulations by which the Society was to be governed.

"Among the papers contributed to the Dublin Philosophical Society by Dr. Willoughby were:—'On the Mirage seen at Rhegium in Italy;' 'On Winds;' 'On the Lines of Longitude and Latitude;' and on 'Hermaphrodism.' Subsequently, Willoughby was elected Secretary to the Society in the room of William Molyneux.

"In the unpublished letter-book of the Royal Society, No. 4123, we find the following letter from Mr. Charles Willoughby to St. George Ash, a distinguished member both of the Royal and of the Dublin Society:—It was read 15th July, 1685.

"'S^r—I have at length prevailed with M^r Towls modesty to hazard an answer to M^r Hirni's impertinent print wch I confess is much below his consideration or the care of those worthy judges wch M^r Hirni has y^e confidence to appeal to. But y^t you may make them some amends, I send you along with it two problems wch he demonstrated before our societie, and a demonstration of one from M^r Halley lately sent hither. I hope they will beg them take measures of y^e man more suitable to his merit than any can be drawn from y^e dicesion of [*not decipherable*] a criticism. I leave all to y^r care, and am

"'Y^{rs} affec^t

"'C. W.'

"Dr. Willoughby was one of the Fellows of the College of Physicians named in the Charter of William and Mary; he took the oaths as such on July 27, 1693; was elected a Censor in the October of that year, and his death was announced at the meeting of the College held on the 18th of September, 1694.

"The following manuscript was discovered a few years ago in a huxter's shop in Dublin, among a collection of the papers of Archbishop King, and is now preserved in the Library of our University. It came into my possession at the same time that the King MSS. were disposed of to our President, Dr. Todd. I print it in the quaint old style in which it was written:—

"'OBSERVATIONS ON THE BILLS OF MORTALITY AND INCREASE OF PEOPLE IN DUBLIN; THE DISTEMPERS, AIR, AND CLIMATE OF THIS KINGDOM; ALSO OF MEDICINES, PHYSIC, AND SURGEONS AND APOTHECARY'S—BY DR. WILLOUGHBY, AN EMINENT PHYSICIAN, IN 1690.

"'The Bills of Mortality have not been kept in Dublin much above 10 years.* I have been constantly served wth y^{m} for those 8 years last past, and thought I had a sufficient stock to make some observations upon, but when I came to review my collection I found it very imperfect, partly by the neglect of servants whom I entrusted to put y^{m} on y^{e} file, and partly by my own frequent absence from home; soe y^{t} I was not able to make up all the yearly bills, and was fain to be content wth those I have here entred; not knowing where to supply my want of y^{e} rest in all Dublin.

"'*Upon the bills of Mortality and increase of people.*

"'I cannot pursue a better method y^{n} what was begun by y^{e} learned author of this new way of observing, S^{r} W^{m} Petty;† therefore, comparing y^{e} mortality of those 7 years, I have collected, I find y^{t} at a middle rate y^{e} yearly mortality of Dublin to be 2236,‡ which exceeds his middle rate, & bears proportion to it almost as 11 to 8, from whence we may reasonably conclude y^{e} people of Dublin to have increast since y^{t} time, almost a 3rd; this was otherwise sufficiently visible in y^{e} great increase of buildings, for a 3^{d} part of y^{e} whole having been erected since y^{e} year 60 [1660] are now fill'd wth inhabitants as soon as finished, wthout any decrease of rent. I find in y^{e} year 1688 y^{e} bills of mortality sink near a 5th of

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* Bills of mortality for the city of Dublin were first attempted in 1661. Sir W. Petty has published the Bill for 1666.—See the "Irish Census Report" for 1851, part v. vol. i.

† See Petty's "Political Anatomy," and "Observations on the Dublin Bills of Mortality."

‡ See the Report on Tables of Death in Census of Ireland for 1851, part v. vol. i.

what they had amounted to in former years; whereas y^e 3 proceeding years came soe near each other y^t y^e 2 greatest, w^{ch} were equall, did not exceed y^e least by more y^n 4 persons, and y^e 4th, which differ most, fell but 42 short of the largest; a small difference, when our whole consists of soe many hundred. This I impute to y^e flight of soe many English Protestants y^t were frighted out of y^e town, as well as y^e rest of y^e Kingdom, by the L^d Tirconnell's being put into y Government.

"'2^{nly}. *Of the Small Pox.*

"'The small pox had raged for some years when I begun to collect my bills [in 1685] and in y^e 1st of my collection it seemed to be in the last of its fury, sinking from 871 y^e very next year to 353; and by comparing of the 1st 6 years together, a midle standard may be collected of 472 for each year; but this last year y^e malignity of it seems to be well nigh quite extinct, not above 47 dying of it in the whole year, and indeed y^e whole mortality decreas't neer a 6th part of w^t it had been y^e year before; tho y^e feavor (of w^h we shall say more presently) kept its usuall pitch, and y^e bloody flux and looseness of w^h there has been a great silence in former bills, now above treble of what they had been before;—an argument that the mortality was not lessened, but the number of inhabitants.

"'3^{rly}. *Of the Feavor.*

"''Tis observable y^t upon the abating of the small pox y^t there came amoungst us an anamalous feavor, w^{ch} Dublin seldom wants, unless in those years when a contagious air impregnates all inflamed bloods with a variolous ferment. This makes me be of opinion y^t a medium for those 7 years being 661 may pass for a generall standard for feavors as long as the place shall continue in its present populousness. I find y^t in y^e year 1688 y^e dispeopling of y^e towne appeared in y^e decrease of y^e feavor, small pox, and y^e whole mortality in generall which was sufficiently repaired by y^e mortality of the following year,

for notwithstanding the great thinness of people w^ch left some whole streets uninhabited, a feavor y^t begun 1^st at the Camp and afterwards w^th the army removed into the city, made the bill increase to almost treble some of y^e former years, and above ½ as much again as the middle standard.

"'4^thly. *Of those above* 16 *and under* 16.

"'This feavor, as it came in w^th the army, soe it continued amoungst us, for in y^t time y^e number of those above 16 outstript those under 16, contrary to y^e constant tenor of former years, which seems to me a cleare argument y^t it was an infection y^t mostly seized y^e adult. This appeared in 2 quarterly bills since last June, & in y^e yearly bill of 1690, for till y^t time y^e odds run on those under 16.

"'Some thought it might have been instructive to compare the list of y^e aged w^th y^t of the infants, till I observed y^t y^e aged did mightily out-number the infants, whereas it is certain in nature y^t more dye in their infancy y^n live to an old age; and y^n I concluded noe inferences could be made of the proportion of aged to infants, from any thing y^t appears upon our bills, since such only were put upon y^e file of infants as dyed w^th out any distemper known to y^e women about y^m, whereas all those y^t dyed of teeth, convulsion, fits, worms, or other children's diseases, are put upon those files, and not upon y^t of infants.

"'5^thly. *A comparison of burialls with Christnings.*

"'S^r W^m Petty observes y^t both in Dublin and in London the proportion of christnings to burialls was alike, the christnings amounting to ⅘ of y^e burialls, whereas in the years we have collected they doe not amount to $\frac{6}{10}$, nay, not to soe much as $\frac{3}{7}$. Whether the reason of that difference may be the number of fanaticks w^ch christen not their children at all, and of papists, w^ch, being more numerous in Dublin y^n formerly, made use of their own priests,—and consequently their baptisms did not

appear upon our church register,—I leave it to others to determine, for wthout such reason the proportion of y^{e} increase of Dublin to its decrease must be mightily lessened, and would in a few years end in an utter desolation of the place.

"'I generally observe y^{t} in all great towns y^{e} burialls doe exceed the births; possibly the closeness of living w^{ch} the neighbourhood of soe many houses built in a narrow compass obliges y^{m} to, may in a great measure be y^{e} occasion of it, nature seeming to require a habitation more at large, and delighting more in an open air y^{n} such as are imprisoned wthin close walls, and not onely the closeness of the walls, but the difference of employments may bear its share, for the country man who dwells in y^{e} open fields is forct to endure in their turns the severity of winter storms and y^{e} scorching heats of summer will, notwithstanding all these hardships, out live y^{e} citizen who spends his days wthin his counter or by y^{e} fireside; and indeed most of the employments of y^{e} commonalty and the recreations of the gentry, contrary to the practice of former ages, are removed from y^{e} open air to within door, much to the prejudice of all those who live wthin citys and great towns. Add hereunto y^{t} y^{e} familys in great towns have usually more single persons in y^{m} y^{n} those of the country, soe y^{t} in conclusion noe great town could long subsist unless recruited from abroad.

"'Dublin has of late years increast in its inhabitants, being supplyed out of England and by y^{e} ffch [French] fugitives: the country was not able to furnish it, being under peopled, and not producing many tradesmen. The Irish are naturally lazy and content to feed hardly upon cheape food w^{ch} is plentifull among y^{m} will therefore betake y^{m}selves to noe industry, and consequently can contribute very little to y^{e} increase of y^{e} city.

"'6^{thly}. *Of Males and Females.*

"'In my observation of the births and burialls of males and females I met wth 2 instances y^{t} differ from S^{r} W^{m} Petty,

tho' he affirm y^{t} in all his collection he never mett wth any, for in the 1st and 3rd year y^{e} number of females y^{t} dyed exceeded y^{t} of males, and the middle rate I found to be as 13 to 13 and near $\frac{2}{3}$ or $\frac{3}{4}\frac{0}{1}$; but in the christnings I found the proportion to be as 13 to 15 and near $\frac{2}{3}$ or $\frac{3}{4}\frac{0}{7}$, soe y^{t} I suppose the compound proportion will not be much different from y^{t} of S^{r} W^{m} Petty's of $\frac{1}{1}\frac{3}{4}$.

" 'Quere, whether an argument may not be hence drawn to prove y^{t} poligamy is contrary to the law of nature, since the stock of females is already slenderer y^{n} y^{t} of males, soe y^{t} if one man ingrost 10 females for his own use, of necessity 9 males would be unprovided for, and since marriage is instituted for the propagation of mankind, it seems reasonable y^{t} every man should beare his equal share in y^{t} grand work.

" 'It will be replyed by some y^{t} mankind has by y^{e} law of nature an equall right to other of natures productions w^{ch} are nevertheless by custom and y^{e} law of nations monopolized into a few private hands; but to this it may be answered, y^{t} y^{e} proprietor can apply but a single share to his own use, & all y^{e} right he can preserve in y^{e} rest is only a power to dispense y^{m} among y^{e} rest of mankind according to his own free will & discreco͞n. Soe y^{t} they may be said to have a derivative right to those goods to w^{h} they may make out their title by some sort of services paid y^{e} proprietor, therefore such an impropriation seems highly advantageous to mankind, since industry is thereby incouraged, and none but the slothfull fall short of their shares; but women are not such a kind of possession, for, not being fitt to be communicated as those other goods may, an overplus of y^{m} cannot wthout great injustice be impropriated by any single person. I know some will alleadge in favor of poligamy y^{t} y^{e} law of nature is better observed among creatures y^{t} live by instinct y^{n} such as act by reason, y^{t} noe species is multiplyed soe fast as the sheep & black cattle; but if all the other males were permitted as well as y^{e} poligamists to herd with y^{e} flock, we should quickly fall into y^{e} in-

convenience of promiscuous copulac̃õns. This is visible enough in those other beasts of the forrest w[ch] notwithstanding y[r] frequent litters and y[e] multiplicity of births at one litter, doe yet in y[r] increase fall much short of the afforemenc̃õned tamed cattle.

"'Another quere may be made whether an argument may not be drawn hence for y[e] celibate of y[e] clergy w[ch] in the time of y[e] Jews was y[e] 12 part of y[e] people, and are now by y[r] maintenance estimated to be a 10[th] part; and in y[e] Church of Roome doe most certainly exceed y[t] proporc̃õn; but if in our church they are but a 14[th], they will be just y[t] part of mankind w[ch] nature has left unprovided of females; & if we consider how much the care of a family distracts those thoughts w[ch] the service of y[e] altar requires, we shall think it a high point of providence in nature to leave those unprovided for whose publick imployments would not permitt y[m] to attend y[e] dutys of a conjugall life.

"'7[thly]. *Of the Flux and by y[e] by of the temper of the Country.*

"'The flux, both white & red, y[e] usuall reproach of this country, has of late years run soe low in our bills, y[t] it seems near extinct, all y[t] perisht of it in 6 of these years not exceeding 364, w[ch] will not amount to 6 in 5 weeks, a small mortality. To what we owe this happy change is not easily determined, unless we impute it to amending of the air, since the draining of soe many bogs since English planters & y[r] husbandry came among us; if y[t] be the true cause, there is a great deale of work yet left for posterity. 'Tis certain y[t] our air is milder and less different from y[e] temper of England y[n] formerly, our winters not soe rainy, & we have upon our bills fewer y[t] dye of consumptions y[n] formerly; & whereas there is a great deale of bog land left yet in Ireland, our country is yet capable of being improved to a greater degree of salubrity; but y[t] work is reserved for some publick purse. It will be beyond the power of a few private fortunes to undertake soe vast an expense. Such an army as was maintained in the time of a long

peace during the reign of the late K^{g} Charles would have been more serviceable to y^{e} public in such a work y^{n} unnecessary watching and warding; and by being kept in continuall action would have been hardened, and made fitter for service in time of need y^{n} by such a lazy life as commonly soldiers lead in time of peace. We discourse, but wth how much truth I cannot tell, of bottomless bogs; if any such thing be, I suppose they must be about y^{e} West of Ireland, where a vast tract of sea, continually beating upon a low shoare, hinders y^{e} earth from knitting, keeping it in a spungy loose texture; and y^{t} may possibly be y^{e} reason of soe many bogs in Ireland more y^{n} in other countrys of its bigness. Yet I will not lay the blame altogether upon nature, and excuse my countrymen from contributing by y^{r} lazyness to y^{r} own misery; it is soe naturall to y^{m} y^{t} I cannot suspect but y^{t} it was as great in former ages as now; for I question not but some of what is now bog land was formerly woodland, and some under other husbandry, w^{ch} by neglect of culture grew in time to have many broad patches of standing water; this soe formed y^{e} globe y^{t} it was unfitt for any of those production w^{ch} other land yields for the service of mankind. A good numerous colony of Dutch, who have given such demonstrac̃õn of y^{r} industry at home, would doe us this service, and a great many others y^{t} we stand in need of, as the erecting of manufactures and sowing of new grains for the use of those manufactures; and others for pasture, sorts of husbandry w^{ch} have [been] attempted by some few, but, like all noveltys, fell again for want of followers.

" ' The quantity of unprofitable land now in Ireland would find work for a great army to reduce it to profitable, w^{ch}, if undertaken by y^{e} Crown of England, would in time turn to its advantage. The Romans in time of peace used to employ y^{r} armys in building of publick Inns, Hospitalls, and Workhouses, in making of causeways, bridges, and vast aquaducts, and other structures of public use and greatness, and if the same were practised here when ever it shall please God to

restore this Kingdom to ye same peace and tranquility it latly enjoyed, ye revenue of ye Crown would quickly be sensible of the improvement; to which purpose I doe humbly propose yt wn ever a parliament is call'd in this Kingdom, an act may be made to oblige every proprietor yt will not improve his wast land himselfe to make over $\frac{4}{5}$ of it to the Crown, upon condicõn to have the last fifth improved to his hand at ye charges of ye Crown. And because order and discipline is very necessary to be continued in any body of men yt live upon the Kg's pay, the soldiers yt are employed in this work may be obliged to march out of yr quarters in rank and file wth drums beating, colours flying, as in time of service, and in the evening to return home again in the same order. The advantages ye Crown will receive by this project are many and great, as a great scope of new Crown lands will be acquired, sufficient to maintain a numerous army out of wch great bodys may be drawn as often as occasion shall require for foreign service. Ireland will thus be made a nursery of soldiers for the use of England, and when hospitalls and workhouses are built, wch ought to be ye next thing after ye improvement of land, since noe country is fitter for ym than Ireland, where provision is cheap, and navigable rivers and good sea ports plentifull, not only the army may be fed and cloathed wth ye produce of yr own labor, but yr wives and children will be provided for in hospitalls and workhouses. This will increase ye people of ye nacõn at present much underpeopled, for whereas women are afraid to venture upon soldiers, who in the time of desparate service run so many hazards of yr lives, and officers are unwilling to entertain married men in yr Companys, both those objections are removed when ye widdows and orphans of such as perish in service are seen to be provided for in hospitals and workhouses, trade would hereby be increast, and large ware houses furnished wth commodityes wch may expect a good market; whereas your scanty trader, who depends more upon ye quickness yn goodness of his return, is often fain to part

wth his goods at an under rate, because he can't afford to be any longer out of his money. It will be argued y^{t} increase of husbandry in this Kingdom will turn to noe account, since w^{t} we have already does much exceed the consumption of the country. I answer, y^{t} y^{e} loss, if any, will fall 1st upon y^{e} private proprietor, and not upon y^{e} Crown, since the great consumption of y^{e} nacõn, being the army, will be served out of the produce of Crown lands, which therefore will never want a vent for y^{r} commoditys, nor is it necessary, if workhouses be erected, y^{t} it should all lye under tillage and pasture. But it may be made to produce other things serviceable for manufactures; in the reign of the late King Charles there was an act of Parliament made for sowing such a quantity in every townland wth hemp and flax, under a certain penalty. The collecting of the penalty was at 1st neglected, and in time it swelled to soe great a bulk y^{t} it would have ruined the nacõn to have paid it all at once. 'Tis pity but y^{t} act should be revived, and the great arrear forgiven, to free the people from y^{e} apprehensions they are in of having it one day demanded; but a severe injunction should be made to collect the penalty for the future, w^{ch}, being small, would be easily paid yearly, or at least prevaile wth y^{m} to put the statute in execution. I have heard some say y^{t} in some townlands there would be no ground proper for hemp and flax, y^{t} others doe not lye neer good markets, where the manufacture can be disposed of on good tearmes; to all which I answer, y^{t} there are other places where, if the manufacture were once begun, a great deal more ground might wth advantage be laid under the same crop, and would be soe undoubtedly, according as manufactures increast amongst us. As for those other places, the loss will not be great to the country if they yield noe profitt, w^{n} in satisfaction of the statute they are sowed with those seeds; for tillage and pasture to w^{ch} they are now converted is already too great for the consumption of the nation.

"'8^{thly}. *Of Consumptions and Convulsions.*

"'The two most remarkable of the rest of the distempers y^t help to swell our bills are convulsions and consumptions; their middle rate is neer the same in both, but in the beginning of y^e 7 years those y^t dyed of consumptions were most; the convulsions, being fewer, increast every year, till at length they out numbered y^e former. The late feavor has been generally observed to be in the *genus nervosum*, and not unfrequently accompanied wth spasmodick motions, & soe y^t it is a doubt whether those who have increast y^e stile of convulsions might not have been as justly put upon the stile of feavers, since in our bills both begat about the same time are increased by y^e same steps. I was once in hopes, by examining the weekly and quarterly bills, to have discovered what time of the year was appearantly more unwholesome y^n another, but I found y^t the acute diseases w^{ch} prevailed in those seasons did by y^r mixing wth the others soe alter the rate of the bills, y^t they rise and fell with great irregularity; but I found y^t in those years in w^{ch} the small pox and feavor reigned, their numbers run highest in the summer season, from June to 7^{ber}, beginning in y^e winter quarter constantly to decrease, nor did the flux w^{ch} is usually imputed to y^e abundance of herrings & bad fruit, rage more in the Autumnall season y^n at other times; however, I^m apt to believe y^t Spring and Autumn, being the verticall seasons of y^e year, doe carry off most of those y^t dye of consump$\tilde{c}\tilde{o}$ns or other lingering distempers, tho' I could not in the bills make out any thing of certainty to demonstrate.

"'9^{thly}. *Of the Irish Air and Climate.*

"'The air of our country is milder y^n y^t of England; warmer in y^e winter, and colder in y^e summer; its only crime is too much moisture, w^{ch} may be mended by the former proposalls; 'tis very unconstant, and seldome continues 24 hours wthout some remarkable change as to heat & cold, w^{ch} makes

* See Dr. Sims's "Observations on the Nervous Fever of 1771."

it very difficult for us to cloath ourselves in y^e morning soe as to serve for all day. We usually complain of too much rain, yet 14 days want of it in any part of summer, except the hay harvest, will oblige us to change our note, the grass withering sooner here in a long drouth y^n in y^e torrid climes of ffrance or Italy, w^{ch} seems to me an argument that the radicall moisture of the productions of this country is of a more discipable watrish texture; this is not only visible in vegetables, but in animalls alsoe, flesh yielding less gravy y^n in England or other countrys. It produces y^e same grain y^t England does, and by good husbandry might be made capable of se^{vall} other productions for y^e service of mankind; but it is generally observed y^t y^r wheat does not yield soe well in a mill as English corn, tho' I'm apt to believe it is not always the fault of y^e grain, but y^e carrying it to the mill before it be thoroughly dry; generally y^e English mault is preferred by those y^t are curious before y^t of our country.

" 'Gardening and orcharding are much improved of late tho' I am of an opinion y^t we can't yet vye w^{th} England; all our late fruit wants the sun to ripen it, and our early blossoms after a milde winter push out soe soon in the spring y^t they are often destroyed by y^e cold winds, w^{ch} our country is too lyable too in y^t season, and to preserve y^m would require more care y^n my lazy countrymen can be persuaded to bestow. Y^e westerly winds blow above 3 parts in the year. In the spring time we have it much North East, and w^{th} it cold weather, I suppose the case may be the same in England, and y^t it is a general draught of air occasioned by y^e melting of the snow of y^t vast continant, w^{ch} lyes east of us. It is remarkable that soe much easterly wind as we have had since this time 12 months has not been known in Ireland.

" 'Dublin stand upon a river y^t runs east and west, and it is made a question whether the north or south side has the healthiest habitacõn; most of the low ground on both sides hath at sev^{all} times been gained from y^e sea, and sev^{all} parts

now neer ye middle of the town stand where ye high water mark once wached. Upon this account many of our habitacõns either want good cellarage; or such as ye have are frequently overflown in ye winter time, and will consequently strike a damp into all ye buildings yt hang over it; but this equally concerns ye buildings on both sides yt stand neer ye river, and will therefore make noe difference. I have heard it observed in Spain yt ye north side of a river is more unwholesome yn ye south, wch, if it be true, I cannot impute to any other cause yn those vapours wch, rising from ye river, are by ye reflected beams of a south sun carryed into ye air, and will consequently hang in a perpendicular line over ye north side, & wn by ye retreat of ye sun and its beams they are rob'd of those their supporters, their naturall gravity will make ym fall down upon those parts yt lye directly underneath the attraction of ye sun beams, wch was a doctrine swallowed down, not understood by the ancients, & has now so much lost its credit as not to need a serious confutacõn. The asserters of it did believe the vapours to run up in ye same line yt ye incident ray came down, as if they had climed up a rope laid there purposely for yr ascent, but since yts noe longer believed, we ought at ye same time to discard ye beliefe of vapours hanging on ye south side of ye river, wch depends wholly upon yt mistaken point of Philosophy.

"'I thought to have made some observacõns upon ye multitude of people, houses, and chimneys; ye unequall contents of parishes; and ye new built ground in each: but as to these particulars, I was not able to get any other yn lame informations, except what Sr Wm Petty has already published on this same subject, to wch I refer ye reader, resolving to dismiss ye rest till I can meet wth some what more of certainty.

"'*Of the Pæruan bark, or Jesuits Powder.*

"'As to the Jesuits powder, it appears to me ye only specifick I know in nature. It attacks all intermittant feavors

wth equall success, making noe difference whether y^{e} patient be old or young, or y^{e} disease in its beginning, hight, or declination, or of w^{ht} temper soever y^{e} patient be, it encounters all equally, and I never knew it miscarry but w^{n} we had just reason to suspect y^{e} genuiness of y^{t} we made use of, and this it performs not by any alteracōn y^{t} can be computed to its 1st or 2^{d} qualitys, as appears by y^{e} insensibleness of any change it makes on other bodys not affected wth this distemper. Artists have analized it, & by se^{vall} changes wrought upon it by fire and otherwise have found out much matter of discourse upon its constituent principles, but as to its vertues collected from y^{m} it proves as fallable as other remedys. 'Tis a forrein concrete, & may serve to teach us y^{t} foreign remedies are not soe very impropper for our bodys as some who are great friends to domestick ones, & think y^{t} every country produces sufficient for y^{e} diseases of its own growth, doe believe; & were y^{t} literally true, yet, in this age, w^{n} our diet is soe corrupted wth y^{e} mixture of forrein sawces as wine, spice, & other ingredients of luxury, it will be noe strange matter if y^{e} diseases y^{t} befall such depraved complexions should not obey y^{e} impulse of domestick remedies, but call in forreiners to y^{r} aid & assistance. Y^{e} imperfectness of physick is much to be deplored since its credible y^{t} nature has provided us specificks for other distempers, but art has not been yet able to discover y^{m}. We have, I confess severall in physick y^{t} goe under y^{t} name, but very undeservedly.

"'*Of D^{r}. Sydenham and his Works.*

"'D^{r}. Sydenham was undoubtedly a good observer, a faithfull register of all his observacōns; but it is to be suspected, he was sometimes a little too hasty in determining y^{e} periods of those mocōns w^{ch} did constitute y^{e} characterestick of y^{e} distemper w^{ch} may be observed by any indifferent practisor to vary y^{r} seasons wth much more latitude y^{n} he doth allow. He has been very honest in rescinding from physick

all ye unnecessary pomp of alteratives & preparatives, and reducing it only to ye use of ye grand remedies wch in physick doe justly fill both sides of ye case. I can easily concurr with him, in ye great admiracõn he has for ye *Jesuits bark*, and doe believe *opium* to be one of ye greatest remedys in nature, tho' I cannot call it, as he doth, ye greatest cordiall, since to perform its effect, it reduces men to an estate more like yt of death yn life, & in a small quantity commands and over comes all ye powers of nature; and if by accident it happened to relieve some, 'tis because nature at yt time needs such a mortificacõn to reclaim its extravagant fury, and reduce it to it selfe. This I speak not as an enemy to opium, for I take more of it my selfe yn some Phisicians who are crowded wth patients find occasion to prescribe, yet I cannot but think, since it is soe indigestable, it has more of a poyson yn a cordiall in it; and 'tis by accident, not any cordiall virtue, yt it performs those surprising cures wch to ignorant spectators seem to have more of magicall yn naturall in ym.

"'*Of Phisicians, Surgeons, Apothecarys, and Hospitalls abroad.*

"'I find noe difficulty to affirm yt our London Doctors are ye most learned and best studyed men in ye world; whereas in all foreign Universitys ye young phisician, after having followed an experienced Dr. for a year or two, and taking notes of his prescriptions, wthout any more adoe commences practiser; the same method here wod be much to ye advantage of young students, if it have not this fault in it—[to] supersede all other Industry or study. I much approve ye learning of all sciences in classes, as it is practised at Leyden, ye public professors there (calculating yr lectures for those raw auditors) neglect yt applause wch might redound to yr endeavours from more learned ears. Surgeons and apothecaries are Itenerant apprentices, removing from one great Hospitall, or one great Town to another; & wn they are grown to a competency of

years and experience in this errantry, they purchase their freedom by some tryall of skill in y^r faculty w^{ch} they perform in publick before y^e Majistrates of y^e place, w^{ch} is testifyed by an instrument under y^e seale of y^e magistracy. I believe if we should deny freedom to all such as leave y^r own country and come to plant among us, we should doe y^m noe injury, for none of y^m having undergone this tryall, they would be noe better y^n journeymen at home, but by our naturall civility for strangers has our law run more in y^r favor.' "

Sir William Rowan Hamilton read a Paper on a new System of Roots of Unity, and of operations therewith connected: to which system of symbols and operations, in consequence of the geometrical character of some of their leading interpretations, he is disposed to give the name of the "Icosian Calculus."

This Calculus *agrees* with that of the Quaternions, in three important respects: namely, 1st, that its three chief symbols, ι, κ, λ, are (as above suggested) *roots* of *unity*, as i, j, k are certain *fourth roots* thereof: 2nd, that these new roots *obey* the *associative* law of multiplication; and 3rd, that they are *not* subject to the *commutative* law, or that their *places* as *factors* must *not* in general be *altered* in a *product*. And it *differs* from the Quaternion Calculus, 1st, by involving roots with *different exponents;* and 2ndly, by *not requiring* (so far as yet appears) the *distributive* property of multiplication. In fact, + and −, in these new calculations, enter *only* as *connecting exponents*, and *not* as connecting *terms:* indeed, *no terms*, or in other words, *no polynomes*, nor even binomes, have hitherto presented themselves, in these late researches of the author. As regards the *exponents* of the new roots, it may be mentioned that in the *principal system*,—for the new Calculus involves a *family of systems*,—there are adopted the equations,—

$$1 = \iota^2 = \kappa^3 = \lambda^5, \ \lambda = \iota\kappa; \qquad \text{(A)}$$

so that we deal, in it, with a *new square root*, *cube root*, and *fifth root*, of *positive unity*; the latter root being the *product* of the two former, when taken in an *order* assigned, but *not* in the opposite order. From these simple assumptions (A), a long train of consistent calculations opens itself out, for every result of which there is found a corresponding geometrical interpretation, in the theory of two of the celebrated solids of antiquity, alluded to with interest by Plato in the Timæus; namely, the Icosaedron, and the Dodecaedron: whereof the *angles* may *now* be *unequal*. By making $\lambda^4 = 1$, the author obtains other symbolical results, which are interpreted by the Octaedron and the Hexaedron. The Pyramid is, in *this* theory, almost too simple to be interesting: but it is dealt with by the assumption, $\lambda^3 = 1$, the other equations (A) being untouched. As one fundamental result of those equations (A), which may serve as a slight specimen of the rest, it is found that if we make $\iota\kappa^2 = \mu$, we shall have

$$\mu^5 = 1, \ \mu = \lambda\iota\lambda, \ \lambda = \mu\iota\mu;$$

so that this *new fifth root* μ has relations of perfect *reciprocity* with the former fifth root λ. But there exist more *general* results, *including* this, and others, on which Sir W. R. H. hopes to be allowed to make a future communication to the Academy: as also on some applications of the principles already stated, or alluded to, which appear to be in some degree interesting.

The following donations were presented:—

1. By Corry Connellan, Esq.:—A copy of Sir Martin A. Shee's portrait of the late Thomas Moore, Esq.

2. By Edward Bewley, M.D.:—An autograph letter of Dr. Charles Lucas, of which the following is a copy:—

"By this time, I may congratulate my worthy, honest friend, first, on his safe arrival with his fair convoy and then, on their kind reception and assured success, in Dublin. I am

just come from the first play I saw since you left the mutilated stage. And had not the capital actor in the great farce of state been there, and commanded, with the journey to London, the King and the Miller, instead of being entertained with Cibber and Dodsley's dramma, I had conversed at home with the living dead, rather than have murdered time with the dead living. How completely has Miss Nossiter and you robbed me of the chief, yea, of all the entertainment, this great town could afford me, the Theatre and my friends? All is dead without you. G. is not always able with offered orders to fill his house. And R. can not get groundlings for love or money to occupy his cold, empty benches. It is unfortunate for the town, that he is old and lacks choler; or poor Harlequin had, before now, hanged himself or broke his neck. Well, what a misfortune it has in all senses proved, that I was forced to travel! Whilst I lay confined to my narrow native place, I thought a Doctor of Dublin an Hippocrates, a Fellow of T. C. D. something more than man; G. Faulkner, another Elziver; Stannard and Singleton honest men; Sheridan a Roscius; Bellamy no w——; and your humble servant, then C. L. of O. Q. apothecary, a much greater man, than I now think C. L. of R. and L. M. D.— Now, how are the mighty fallen! All fallen so low in my esteem, that I think few or none of them worth the insignificant notice of——mine insignificant self. See, I prate, as when I ingrossed you by your hospitable fireside! Let me say something serious. The remnant of your family is well. So are all your friends, who for themselves mourn your loss, whilst the exult at your prospects, and see a falling house here unmoved. Atkinson and his worthy wife are well. Br. a villain! He will not quit the business. Adair, wrote letters for you to my house; he has forgot *the* letter, and I could not explane it to him. Convent Garden is on the brink of Damnation; psha! it was always so; I mean the theatre: Nothing less than G. ii, or G. iii, to be, no less actors, in all

Monarch R——'s dramatic list, can bring a house. Hamlet, the second night, scarce payed expences; Shylock, not much better; Hippolitus twice, still less. How hard is the man's fate, whose salvation depends upon pantomimes and burlettos? In short, our Dublin Roscius will hardly get bread as a candle snuffer here. Would you believe it? Sparks and Elmy were the most applauded in the Journey to London. This entre nous, damn the french! Whist is the word. In short, Nossiter and you have hurt me, as much as if you had mended mine hearing, where I was to hear nothing but dissonance and discord, or my smelling, when stenches alone were to be presented to that sense. And now I talk of stenches, I long for once to offend mine eyes, sense of cleanliness and smell, with the sight of Faulkner's nasty newspaper, that I may wade through heaps of lies and non-sense to see your names and hear something of you. How did you travel? How cross the seas? How does the sod agree with you? How is Mrs. Barry? How is Belzy? Have you forgot me? Shew me you have not by writing. Do you all know how I love you? Think of it and let me hear often from you. Do you know that I am very well and hearty? Are not you all glad? Yes; I know you are. I want nothing but to hear of a victorious campaign and see you returning triumphant to your longing friends here. G. was not better received or dismissed to night than you will be. See, my paper is out; so is the poor post-man's hour. Farewell! then, my honest friend. When next you embrace your wife, give her a Blandishment for me, and give Bell not a few. O! happy Proxy! Remember me tenderly to all those, that love you as I do; for they can not be Enemies to him, who with no less pride than truth professes himself Your most affect^te^ and faithful friend,

"C: Lucas.

"London, Nov. 9th. 1754.

"Kennedy, Kennedy."

3. By Francis M. Jennings, Esq.:—A collection of modern personal ornaments collected by himself in the north of Africa, viz.:—A necklace composed of amber and ornamented glass beads, with silver pendants, with patterns in niello; a silver chain connecting two small fibulæ; and a copper armlet. These all resemble things of the same kind found in Ireland.

4. By Thomas Grubb, Esq.:—A photograph of certain plaster casts of ancient crosses in the collection of the Academy, intended to exhibit the application of an improvement in the waxed paper process applicable to the representation of such objects.

5. By William T. Potts, Esq.:—An ancient iron spear-head, of a very peculiar form, found at Lesjo, in the Romsdahl valley, near Christiansund, in the track of Sinclair's expedition to assist the Swedes against the Norwegians.

6. By Dr. Kelly, Mullingar:—An ancient bronze blade, of a very rare form, found in the neighbourhood of Mullingar, similar to a much smaller one in the Academy Museum.

7. By J. F. Rowland, Esq., Drogheda:—Three encaustic tiles, found at Mellifont Abbey.

The Secretary handed in a list of donations of books and pamphlets presented to the Library during the recess.

The thanks of the Academy were voted to the several donors.

The Academy then adjourned to Saturday, 29th November, 1856.

Saturday, November 29th, 1856. (Stated Meeting.)

JAMES HENTHORN TODD, D.D., President, in the Chair.

The following Recommendation of the Council having been read by the Chairman, viz.:—

"That the first clause of the Recommendations respecting the rotation of the Council, adopted on the 30th November, 1854, be repealed, viz.:

"'That it is expedient that one member of each Committee be removed in each year, in addition to any vacancies which may be caused by death, resignation, or non-attendance.'

"And that the following be substituted for it:—

"'That it is expedient that one Member of each Committee be removed in each year, in case no vacancy should occur on that Committee by death, resignation, or non-attendance.'"

It was moved as an amendment by the Rev. Joseph A. Galbraith, and seconded by Frederick J. Sidney, LL.D., and—

Resolved,—That the Resolution proposed by the Council be referred back again to the Council, with the recommendation that the words "And the Vice-Presidents" be omitted from clause 2 of the Resolutions of Nov. 30, 1854,* with respect to the mode of electing the Council.

Rev. Samuel Haughton read a paper on some Experiments on the Poisonous Properties of Strychnine and Nicotine.

Mr. Haughton stated, that he was induced to make the experiments which he now brought under the notice of the Academy, by the consideration of the specific actions of strychnine and nicotine upon the muscular system, which appeared to be so opposite in their character as to lead him to

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* See Proceedings, vol. vi. p. 133.

a conviction that they might prove to be mutually antidotes to each other's action. It is generally believed that strychnine exerts a specific action upon the lower or lumbar portion of the spinal column, exciting the muscular system (at least the voluntary muscles) into a state of tetanic contraction, and ultimately producing death indirectly by rendering respiration mechanically impossible, by virtue of the permanent contraction of the pectoral muscles, and not, as was once supposed, by its action upon the heart. It is also well known that the most powerful agent we possess for relaxing the action of the muscles is nicotine, whether administered in the form of tobacco smoke or infusion of the leaves. From these well-known facts, Mr. Haughton was led to believe that these powerful poisons might be used as antidotes to each other's action; and, with the view of testing this conjecture, he made the following experiments:—

First Experiment.—Nicotine.

A bath consisting of 5 ounces of water, holding dissolved 5 grains of nicotine, of 1012 specific gravity, was prepared, and in this mixture a frog was immersed; in 55 seconds the animal became narcotized, and apparently incapable of motion; but on being excited and stirred, it was evident that life was not extinct, and the pulsation of the heart did not cease until 23 minutes after immersion. The anterior extremities became paralyzed first, accompanied with a quivering of the forelegs, and then the hindlegs were drawn up so as to reduce the animal to the smallest possible compass. At the time of death, the belly and hindlegs became suffused with a pink tint, which was rapidly diffused, commencing at the thighs. After death the mouth remained closed, and the eye continued very brilliant and life-like.

Second Experiment.—Nicotine.

A solution of nicotine was formed, consisting of 5 grains of nicotine to 20 ounces of water; and a frog immersed as

before, leaving his head above the water; in $3\frac{1}{2}$ minutes he became quite paralyzed as before, placing the forelegs upon his back with the palms upwards. Death finally ensued in 43 minutes, with the same appearances as those described in the first experiment.

Third Experiment.—Strychnine.

In this experiment 5 grains of pure strychnine were dissolved in a minimum of muriatic acid, and 5 ounces of water added. A frog was placed in the bath thus formed, with the following results:—Tetanic convulsions set in immediately upon his touching the liquid, and continued while life remained; there was no sign of opisthotonos, but strongly marked emprosthotonos. The animal was quite dead in 4 minutes; mouth open, and eye closed and death-like; the whole body stretched out and bent forwards, the back being highly arched.

Fourth Experiment.—Strychnine.

A bath was made of 5 grains of strychnine and 20 ounces of water, and a frog placed in the solution, as before. The animal became speedily convulsed, and exhibited the same symptoms as in the former case; but in this case death did not finally take place until after an interval of 55 minutes. The mouth was open, the eye closed and dead, and the body arched and bent forwards, as before.

Fifth Experiment.—Nicotine and Strychnine.

In this experiment, two baths were prepared; one of 5 grains of strychnine to 5 ounces of water, and the other of 5 grains of nicotine to 5 ounces of water, and the two solutions carefully mixed together. A frog was now introduced, and remained apparently without inconvenience for 19 minutes, when the strychnine began to operate, and the first tetanic convulsion appeared; the usual appearance of strychnine poisoning continued, but with less violence than in the former experiments; after 47 minutes the animal was removed from

the bath, and washed with cold water; he lived afterwards for upwards of 24 hours, exhibiting at intervals tetanic convulsions.

Sixth Experiment.—Nicotine and Strychnine.

Another frog was placed in a mixed bath of nicotine and strychnine of the same strength as that last described, and removed after an interval of 10 minutes. After removal, in 32 minutes, the first symptom of emprosthotonos appeared, and the convulsions continued for many hours; but the animal ultimately recovered completely, and is still in the enjoyment of health and life, after a lapse of many days.

The last two experiments appeared to Mr. Haughton conclusive as to the action of nicotine in retarding, and, in certain cases, completely counteracting the effects of strychnine. In the fifth experiment, a frog had lived for 47 minutes in a mixture of two solutions, of which one would have destroyed life in 4 minutes, and the other would have produced paralysis in 1 minute, and destroyed life in 23 minutes; and yet, in the mixture, the animal had lived for 47 minutes, and afterwards for 24 hours.

In the sixth experiment, the frog immersed in a similar mixture of the poisons for 10 minutes had ultimately recovered; the effect of the strychnine being completely obviated by the action of the nicotine.

Mr. Haughton considered that these facts which had come under his notice, gave rise to much interesting speculation, into which, however, he had no desire to enter, as he preferred leaving such topics to those who were more immediately concerned in them; and he expressed a hope that further inquiries would be instituted into the action of strychnine and nicotine upon some of the warm-blooded animals, as he believed that in nicotine, which was always easily procurable in the form of tobacco-leaf infusion, would be found a valuable antidote in at least some cases of strychnine poisoning, whether intentional or accidental.

The Secretary read the following extracts from a letter from the Rev. T. H. Porter, accompanying the donation of a very large wooden vessel to the Museum of the Academy:—"It was found some months since, at a considerable depth in a peat bog at Gortagowan, in this parish (Desartcreat, county of Tyrone), the same bog in which three former wooden articles, which I had the pleasure of sending up to the Museum, were found. It lay bottom uppermost, and was much shattered by the diggers in taking it out. But it is remarkable that it had been split in different places before it was submerged; as is plain from the several slips of hard wood, with holes for pegs, found with it; one of which is now attached where it was originally put on. The poor owners must have had it a long time in use, and must have valued it highly. A long slender pole, apparently of willow, or some other pliable wood, was found near it, but much damaged. Within it was a quantity of dark brown stuff, of which I have a sample; it seems to be merely the finer parts of the peat, filtered in by the water."

MONDAY, DECEMBER 8TH, 1856.

JAMES HENTHORN TODD, D.D., PRESIDENT,
in the Chair.

THE Secretary of the Council read the following Recommendation of the Council, adopted by the Academy on the 30th November, 1854, viz.:—

"1. That it is expedient that one Member of each Committee be removed in each year, in addition to any vacancies which may be caused by death, resignation, or non-attendance.

"2. That the Members so to be removed should be the senior Member of each Committee, with the exception of the Secretary of the Academy, the Secretary of the Council, the Treasurer, the Librarian, and the Vice-Presidents."

And moved:—That the following Recommendations of the Council, adopted at their meeting held 3rd December, 1856, be substituted for them:—

"1. That it is expedient that one Member of each Committee be removed in each year, in case no vacancy should occur on that Committee by death, resignation, or non-attendance.

"2. That the Member so to be removed be the senior Member of each Committee, with the exception of the Treasurer, the Secretary of the Academy, the Secretary of the Council, and Librarian."

George Petrie, LL.D., moved, and John E. Pigot, Esq., seconded the following amendment:—

"That it be recommended to the Council to consider the propriety of removing the exemption accorded to the Officers of the Academy of being removable from the Council by ro-

tation. And further, that the Member of each Committee to retire from the Council be that one who has given the least number of attendances during the year."

The amendment having been negatived, the original Recommendations of the Council were put and carried.

In the absence of the author, the Rev. T. R. Robinson, D. D., Sir Robert Kane read a second notice on the Luminous Phenomena produced by the discharge of Ruhmkorff's Induction Apparatus in vacuo:—

"In the Proceedings of the Academy, January, 1856, I have given an account of some observations respecting the appearances produced by the discharge of induction currents through an exhausted receiver; especially the division of the luminous stream into a number of spherical shells, whose centre is the point from which the positive discharge issues, and the influence which the presence of gaseous or vaporous matter has on the production of those rays which have the power of exciting fluorescence. Since that time I have pursued the subject at such few moments of leisure as I could find; and I hope the facts which I have observed may not be unworthy of the Academy's notice. If it seem that I detail them too minutely, it must be remembered, that as long as we are ignorant of the cause of a phenomenon, it is impossible to decide as to the importance and significance of any of its features.

"Nothing satisfactory has yet been ascertained as to the cause of the stratification of the light. Mr. Grove, in a communication to the British Association at Cheltenham (which I know only from a very brief notice in the 'Athenæum'), appears to think that it arises from some vibration in the metal of the contact-breaker, which produces a fluctuation in the inducing current. He finds that it is not always visible in the light caused by a single discharge, and that it is influ-

enced by the nature of the metals between which the interruption spark occurs. The opinion of such a man is of great authority; yet it is not easy to see how this can produce such an effect; and the following observations appear to show that other circumstances must also be concerned in it:—

"1. I tried the effect of frictional electricity from a machine of two 18-inch plates in powerful action. The lower electrode was an inch ball, screwed into the opening of the pump-plate (which is of glass): the upper was a point, 7 inches distant. The receiver was filled with dry hydrogen. On exhausting to 1^{i}·0, the light appeared filling the receiver, and did not pass in a central stream till 0^{i}·09. At 0^{i}·06 a few faint bands were seen near the ball, which, with its stem, had a faint envelope surrounded by a brighter one, but no difference of colour. The light was greenish, producing no fluorescence, and very much fainter than that produced by Ruhmkorff. Nothing was gained by including a jar of one-third foot coating discharging at 0^{i}·10. With the air vacuum 0^{i}·15, the light was violet, much fluorescence, and the bands less distinct.*

"2. An 'electric egg,' 8^{i}·5 high, and 6^{i} diameter, was filled with hydrogen.† The balls of its wires, 0^{i}·25 diameter, were set 6^{i} apart, and it was exhausted to 0^{i}·17 (the pump not acting well then). The Ruhmkorff was excited by four Groves giving in air a spark 0^{i}·52. When the current

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* Within the last few days I had an opportunity of reading the last two years of Poggendorff's "Annalen." In the 7th Number of this year I find an important observation of Herr Van Willigen. He saw dark bands in the discharge of the Leyden jar through a vacuum of 0^{i}·12 (containing vapour of oil of bergamot), when a wet string is included in the circuit. Hence, he, and Poggendorff subsequently, infer that they require a certain retardation of the discharge. It seems rather to confirm Mr. Grove's view of a certain undulation in the current being necessary.

† The gases were always dried by being slowly passed through a capillary tube immersed 6^{i} in sulphuric acid.

through the primary coil was reduced to 0·52 of my unit, the machine worked, though feebly, and the light was pale and cylindrical, *without a trace of stratification anywhere.* As the current was increased, the outline of the light became elliptic, but no bands were visible *till the current* = 1·51, and then only a few at the positive ball. With the full current = 3·60, they were brought out in perfect development. It deserves to be remarked, that when the lower ball is positive, the central light almost touches the other ball; but when the current is reversed, there is the usual dark interval at the negative. The glass of this egg is thick, and very fluorescent, and absorbs completely the few rays of high refrangibility which are produced in the hydrogen vacuum, so that none of the tests are affected outside.

"3. Occasionally I use a Smee's battery of six cells, with plates the same size as my Groves. It is, however, very inferior to Grove both in power and constancy, the *six* not giving as strong a current with the Ruhmkorff as *one* of the others. Connecting it, when excited by them with a receiver in which was a hydrogen vacuum = 0ⁱ·08, the meniscoid strata were *at first* very distinct, but faded away in a few seconds. The lower electrode was a point, the other an inch ball, in which there was a hole about 45° from its stem. Out of this darted a curious funnel of pink flame, passing through the interior envelope and the dark shell which surrounded it, and spreading itself into the exterior brighter one. When only the exterior terminal of the Ruhmkorff is connected with the upper ball, the light is faint and without stratification: the ball has the two envelopes with the dark interval, which cease at its equator, and this whether it be positive or negative.

"4. In strong contrast to this is the powerful development of stratification, when there is passed through the hydrogen vacuum 0ⁱ·07 the current of two Ruhmkorffs, excited by a triple Grove, and, as Foucault proposes, connected by their interior terminals and their exterior terminals, oppositely

electric. This arrangement gave in air dense sparks $0^{i}{\cdot}8$ long. The appearances were very fine. A few of the menisci near the positive ball were $0^{i}{\cdot}2$ broad, and did not fine away at the edge as much as usual.

"5. Wishing to prevent the diffusion of the luminous stream, I screwed on the point a disc of gutta percha, of such size as to touch the glass. With air vacuum $0^{i}{\cdot}05$, and Smee, when the point was positive, a few menisci were occasionally seen near it; but when a hand was brought near the receiver, they *were much more strongly developed towards it*. When a Leyden jar (each coating about a foot) was connected with the terminals, the stratification was well seen in each direction of the current. With the two Ruhmkorffs combined, and three Groves in series, the effect was magnificent: all the distance from the point to an inch from the ball was covered with bright yellowish-green menisci: the envelopes of the ball were broad, and the cone of pink light from the hole already mentioned dazzling. Reversing the current, the outer envelope of the point sent several bright streams round the gutta percha, which partly fused it. With air vacuum $0^{i}{\cdot}10$ the appearances were less intense; the stratification reached only half way, and the envelopes of the negative ball were not one-fourth of their previous bulk.

"6. The destruction of the gutta percha made me replace it by a disc of plate glass 3^{i} diameter, with a small hole drilled in the centre. To this is cemented a tube of gutta percha, which slips on a wire screwed in the pump-plate, whose point projects $0^{i}{\cdot}1$ above the glass. This arrangement gives beautiful results. With air vacuum $0^{i}{\cdot}07$, and Smee, when the point is positive, on first passing the current the menisci appeared at the dark space near the ball, then in a few seconds travelled *down* the column of light, like waves from a stone thrown into water, and when they reached the point, disappeared. If the ball was positive, the column of light had an elliptic envelope reaching to the dark part. Be-

low this the point had its envelopes and the blue light, above which was a convex haze reaching to the edge of the glass, and streaming round it in a pink cone to the brass nut which secures the glass plate. With two Groves the strata were permanent, but cannot be called menisci, as in *this arrangement* the decrease of thickness at the edge scarcely occurred.

"7. This, with hydrogen vacuum $0^{i}\cdot05$ and two Groves, gave far less light than in the air vacuum. There was no fluorescence with sulphate of quinine, but a little with platino-cyanide of potassium.* With the ball positive, the spherical shells were well formed, but only through half the column of light: below that was luminous haze down to the dark interval near the point. When the point was positive, the shells *were perfect hemispheres, with the glass disc as their diameter, and reaching to its edge:* above that they were lesser segments, which did not extend to the glass of the receiver.

"8. Substituting for the ball a glass disc similar to that below, and depressing the points $0^{i}\cdot05$ *below the surface* of the glass, air vacuum $0^{i}\cdot08$, four Groves, this seemed to interfere with the production of the strata, which were scarcely perceptible, and the stream of light, though intense, was narrow. Making the lower point to project $0^{i}\cdot10$, as before, they were much plainer when it was positive, but scarcely to be seen when it was negative. Replacing the ball, they were, as usual, spreading out into the faint envelope. When the induction circuit was not continuous, but completed by dropping sparks on the bind-screw of the pump-plate, or on a globule of mercury placed there, no change was produced in their appearance. When the contact breaker was surrounded by alcohol (which reduced the spark in air from $0^{i}\ 42$ to $0^{i}\cdot34$) there was no alteration, except what arose from the diminished current.

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* For this I am indebted to G. G. Stokes, Esq. It is the most sensitive test of fluorescent rays that I know.

"9. Supposing the vicinity of the glass of the receiver to the luminous stream might have some effect, I used a larger one, 6^{i} internal diameter, and allowing 6^{i} from the ball to the glass disc. With Smee and air vacuum 0^{i}·04, the hemispheres covered the disc, about 40 to the inch, in the stream above still closer; but besides these, others were occasionally seen, broad, hazy, and *not curved*, which seemed to move rapidly, if the eye was suddenly depressed. These are, probably, an optical deception.

"10. With hydrogen vacuum and Smee, at 0^{i}·70, the ball positive, the stream was bright, and covered with fine black bands: then it broke into a faint broad one, with lateral brushes to the glass, in which no bands were visible. With the point positive, the stream was bright, 0^{i}·4 broad, reaching 0^{i}·5 from the ball, and all covered with fine sharp bands. Round it was a faint envelope, into which the bands occasionally darted out, *but only every second or third one*. At 0^{i}·6 the bands became hemispheres, covering the whole glass disc, full twice as broad as the first set, but worse defined, misty, and the intervals not absolutely dark. The mass of light ended in a cone, whose point was about 1^{i}·5 from the ball.

"11. I was indebted to Mr. Mallet for the use of a large Ruhmkorff: it was the same diameter as mine, 4^{i}, but longer, in the ratio of 11·5 to 7. It did not give a longer spark in air, but a far denser one. Excited by four Groves, hydrogen vacuum at 4^{i}·2, the discharge passed in faint ramifications. At 1^{i}·70 it was a bright ribbon, 0^{i}·25 broad, between green and lilac, covered with faint bands, which attained their maximum of distinctness at 0^{i}·70. At 0^{i}·14 the appearances were the normal ones of this vacuum, but finer than I had ever seen them. When the ball was positive, the shells wrapped round it, and were a little flattened below it on each side of the axis.

"12. Admitting air and exhausting, the discharge passed at 2^{i}·70, in bluish branches, filling the receiver. At 1^{i}·52 it

passed in a single red stream, but without bands. At $0^{i}{\cdot}04$ the spherical strata and the rotation were admirably developed. It was especially beautiful when the ball was positive. The blue hemisphere on the point was surrounded by a dark shell, whose projection on the disc looked like a black ring. Round this was a pink one, which folded round the disc, and formed the cone already described. In this also were bands, which, at the part which bent round the edge, looked like fiery spikes. I have never seen stratification in the blue light.

"13. Vacuum of coal gas, which had been passed through sulphuric acid, $0^{i}{\cdot}03$, Smee, point positive; the light was bright green; pink stars on the point; lilac shell on ball. The strata were very fine, but flattened on each side of the axis; there also were broad secondary bands, as in (9), which sank down like waves. The ball, when positive, was wrapped in a luminous haze, and covered with green stars; others were on the point. After a few seconds the strata became faint. There was barely a trace of fluorescence with the platino-cyanide.

"14. Air vacuum $0^{i}{\cdot}025$, Smee. With the point positive the strata were very distinct at first, but soon faded: there were also the broad shadowy bands which *this time rose*. Stopping the action of the battery for 60^{s}, the strata reappeared: once or twice the light reached the ball, *without any intervening dark space*. When the point was negative, the glass disc was covered with circular rings, which continued round its edge and down the cone, as in (11) and (12), with higher electric power, but less exhaustion.

"15. With hydrogen vacuum $0^{i}{\cdot}12$, and two Groves, the electrodes being a half-inch ball screwed into the pump-plate, and a brass plate closing the top of a tall receiver, with a distance of 17^{i} between them, there was scarcely any stratification. This was also the case with the air vacuum; but when the distance was only $5^{i}{\cdot}5$, they had their usual character, and were very distinct.

"These experiments indicate three things, as exerting a potent influence on this peculiar stratification of the light, the chemical character of the medium, its density, and the intensity of the induced current which is discharged through it. These three may be reduced to one, namely, the quantity of electricity which is transmitted in a given instance; and which depends on the conducting power of the circuit and the electro-motive force. The superiority of hydrogen and coal gas over common air arises from their being better conductors; and as any gas becomes a better conductor by rarefaction, this explains why, through the whole series, the phenomena are most distinct when the vacuum is best.* Indeed, for each gas there seems to be a limit of density above which stratification does not occur. Thus, for hydrogen, the bands were not seen (10) till its pressure $= 0^{i}\cdot70$, and in another instance (11) where the electric tension was higher, till $1^{i}\cdot70$. In air I have never seen them when its density was more than $0^{i}.30$. This limit will be highest for the best conductors; but it is seen by comparing (14) with (7) that inferior conducting power may be more than compensated by higher exhaustion.

"The proofs of the influence of electric tension are still more numerous. In (3), (6), (13), and (14), where Smee's battery was used, the strata, though distinct at first, faded away in a few seconds, reappearing when the circuit was broken for a short period. The power of this battery, like that of other single fluid ones, declines rapidly when the circuit has small resistance, and recovers when that is broken; and in these two states the induction spark in air was $0^{i}\cdot20$ and $0^{i}\cdot05$: this decline caused the disappearance. The trifling effect of frictional electricity (1), as compared to that of the

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* As the rarefaction proceeds, the intensity of the spark at the contact breaker decreases; and so also we should suppose the vibration there; yet the stratification becomes more decided. This seems against Mr. Grove's hypothesis.

induction machine, depends obviously on the inferiority of quantity; and the difference (15) when the distances of the electrodes are 17^{i} and $5^{i}\cdot 5$ must be referred to the same cause. In (5) the hand acts by facilitating the passage of the electricity, and in (6) and (7) the stratification increases in distinctness with the increase of the battery current passed through the primary coil. In (8) and (11) the battery power is the same, but the latter has a more powerful induction coil, and its effects far surpass the other. Still more striking is the effect of combining two machines, (4) and (5), where the power of quantity over this phenomenon is manifest; and that of connecting a Leyden jar with the terminals of the induction coil, which decidedly weakens the spark at the contact breaker, is also considerable. And it appears from (2), not only that it increases with the current, but that a certain amount is necessary to its production, less, as might be expected, for hydrogen than air. That the electrodes of the induction discharge exercise a decided influence on this phenomenon is shown by (7) and (8). In the latter the quantity of electricity which passed was probably less, but in the other the appearance of the hemispheric shells covering the whole disc is very striking, and suggests the idea of two systems of waves emanating from the positive point. It seems desirable to study the effect of points of different substances; of the various velocities of the contact breaker; and of very intense induction,* and I hope soon to be able to do it.

"In my former paper I expressed an opinion that oxygen and nitrogen are the only gases in which the electric discharge produces those rays which cause fluorescence, and promised to examine others besides those mentioned there, by means of

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* A very great increase of this machine's power has recently been made by Ruhmkorff himself, by Stöhrer of Leipzig, and still more by Heerder of Plymouth. We are, probably, far from the limit, though it has given sparks exceeding three inches.

a peculiar apparatus which I described. This I have done, though not as far as I wish. The plan of closing the bell which is mentioned there, failed on trial; and I used as a valve a disc of iron, having in its centre a convex projection fitting the hole, round which is a thin washer of vulcanized caoutchouc. This is kept tight by a screw, the head of which can be caught by a hook on the sliding rod of the receiver, and the bell may thus be raised (for I found its flotation uncertain). The bell holds 19 inches, and the little jar which I use to transfer gas into it holds $\frac{1}{67}$, so that the density when it is in its normal position = $\frac{1}{1277}$. At first some air adheres obstinately to the bell, and some escapes from the pores of the iron core, in spite of varnish; but after repeating the process three or four times, no trace of it appears. The distance between the iron disc, and the surface of mercury which is the lower electrode = $5^{i}\cdot5$.

"16. When no gas is introduced, I presume the vacuum contains nothing but mercurial vapour; with Smee the disc was covered with a film of pink; then there were broad, bright, green, spherical shells extending across the bell to a radius of $1^{i}\cdot5$. From them a faint haze spread down in a cone, so as actually, or almost, to meet a similar cone rising from a stratum of bright, blue light (in which no stratification was visible), floating on the mercury. The whole is so like the appearance in hydrogen, that I feel almost sure the latter is a *gaseous metal.* There was no fluorescence; but as I had learned from (2) that it might be concealed by the absorption of the glass, I lately repeated this experiment, placing on the *inside* of the bell's dome a spot of sulphate of quinine, and one of platino-cyanide of potassium. When the disc was positive, so that these tests were enveloped in the green menisci, they showed no fluorescence whatever; when it was negative, and they were exposed to the blue light, the platino-cyanide showed the faintest possible trace; the other none. This vacuum is a worse conductor than the external air one, $0^{i}\cdot15$.

"17. Introducing the jar with air, which gives the vacuum

$0^{\mathrm{i}}{\cdot}02$, the light is of the usual violet colour, the fluorescence strong, and the spheric stratification the most distinct which I had seen with air. When the disc is positive, the form of the light is as in the preceding; when negative, there is a sheet of pink light on the mercury, and the bell is full of dazzling blue, as fluorescent as the other.

"18. Vapour of carburet of sulphur: a few drops are poured into the transfer jar, which is then filled with mercury, so as to displace all except the film which adheres to the jar. This, when the jar rises out of the hole, is vaporized: with water the quantity which thus adheres = $\frac{1}{13}$ grain. In this case the tension of the vapour was about $0^{\mathrm{i}}{\cdot}15$, as estimated by the height of mercury in the bell, compared with the gauge. The light was bright yellow green, the strata superb, but no exterior fluorescence. In a short time it was decomposed, the bell being coated with sulphur, and the mercury with a red film, probably cinnabar.

"19. Vapour of chloroform seems to conduct badly: the light is greenish, but with many branches; no fluorescence, and strata indistinct. The vapour was probably too dense.

"20. A bit of phosphorus, carefully dried, was passed up into the transfer jar. At first the appearance was as in (16), but as the phosphorus evaporated, one of the hemisphere shells about $0^{\mathrm{i}}{\cdot}5$ diameter became brilliant gold colour, and stretched itself up and down, while the others changed colour also, becoming bluish-white. It then shrunk into a film, coating the disc, but retaining its peculiar splendour. Below them, for a third of the whole, there was a dark space, and orange light on the mercury; no fluorescence with quinine, and very little with platino-cyanide. Reversing current, the disc is orange, and the bell full of white light, which soon separates from the glass, forming a cone. Much phosphuret of mercury is formed. This is the most beautiful *spectacle* of all which I have seen.

"21. Sulphurous acid gas: I had some trouble in filling these miniature jars ($0^{\mathrm{i}}{\cdot}1$ diameter), but did so by means ob-

vious to every practical chemist. Four were always filled, and tried in succession. The light in this was a rich lilac, with a bright central portion. Platino-cyanide looked dull white; but uran glass and quinine drawings scarcely showed anything.

"22. Iodine acted so rapidly on the mercury, and obscured the glass, that I could observe nothing.

"23. Hydrochloric acid was so bad a conductor, that I had difficulty in preventing the discharge from passing outside the bell. The light was yellowish-gray; no strata, and less fluorescence than hydrogen.

"24. Cyanogen was not like any other I had seen: the light is a deep lilac, no blue at the negative electrode, but only a deeper tint of the general hue. It *is very fluorescent*, not perhaps quite so much as air, and the discharge is less luminous. After some time a change takes place, for the light becomes greenish, and the strata are more sharp; perhaps cyanide of mercury is formed.

"25. Vapour of naphtha gave nothing peculiar; the light was livid blue, and scarcely a trace of fluorescence.

"26. Vapour of alcohol: the light was brilliant beryl-green, and orange at the disc when positive; bare trace of fluorescence with the platino-cyanide.

"27. Fluoride of silicium gave an indefinite colour between lilac and green, reaching nearly to the mercury, where it was a strong brownish-yellow. The disc, though iron and positive, was covered with stars of green light, and there was only the faintest fluorescence with platino-cyanide.

"28. Dentoxide of nitrogen differed in nothing from air, except that when the disc was negative the combustion was more vivid, and sparks of burning iron were thrown off.

"29. Ammonia gave a pale livid light, with *scarce a trace of fluorescence*, though the strata were highly developed.

"30. Vapour of water is so bad a conductor, that the discharge would not pass till the density in the receiver was

$3^{i}\cdot5$, which reduced the striking distance to 2^{i}. The light was *greenish*, faint, and fluorescence almost insensible.

"31. Concentrated acetic acid showed nothing worth notice; the light was livid, and fluorescence very faint.

"32. A fragment of camphor was fixed by pressure on the disc. The light was green, like that of alcohol; when the disc was positive, it was covered with intense emerald stars, and the mercury with bluish-green light, brighter than the rest. This was still brighter at the disc when negative, and red sparks flew from it. No fluorescence.

"33. This was again tried in the air vacuum $0^{i}\cdot25$, but with four double Groves. The light was light green, but the stream narrow, and the strata were well defined. Red sparks flew from the negative electrode; quinine drawings were not visible outside, but one attached to the inside of the glass was seen faintly. This was probably caused by the residual air.

"It follows from these facts, that though my original conclusion, that the fluorescent rays can be produced only in oxygen and nitrogen, is not rigorously true; yet that in this respect they very far predominate over the others. It appears from (27) that they do not lose this quality in combination; and from (23) that nitrogen is not deprived of it by carbon, though it is (28) by hydrogen, which seems eminently anti-fluorescent. It, sulphur, and carbon, seem entirely to destroy this power in oxygen; and probably the case is the same with all other highly electro-positive substances. Equally deserving of notice is the power of developing green light which seems to belong to the compounds of carbon. There remains a wide field for inquiry on these points, especially with respect to the various ethers and bodies of the same family, and also to the remaining electro-negatives, on which I hope soon to enter, with the advantage of having in some degree ascertained the difficulties which are to be encountered."

Rev. Charles Graves, D. D., read a notice by Richard Hitchcock, Esq., of an Inscription in the Ogham character.

"Sept. 2, 1856. I visited the Ogham monument discovered in Cahernagat, one of the ancient circular stone enclosures on the townland of Ballywiheen, about two miles to the north-west of Ventry. It was discovered by the Rev. James Goodman, in October, 1855,—whose short account it may be well to give:—'I discovered also at the "Cathair-na-gat" (caṫaıṗ na ᵹ-caᴛ), on the same farm, a large Ogham stone, with the most perfect inscription I have ever seen. It was covered with rubbish, and probably never came under your notice. I got half a dozen men, and with their assistance had it placed standing on the top of the Cathair.' I found the stone standing as placed by Mr. Goodman. It is one of, if not the most, beautiful Ogham stone monuments now on our list, being longitudinally streaked on both sides, which are flat, in a rather artistic manner, with purplish-coloured lines, such being the nature of the stone. Numerous similarly streaked small stones may be seen in the fences in the immediate vicinity of the Caher; and of these I have brought a few specimens, which may give some idea better than description of the beautiful nature of this fine Ogham monument. The following are the dimensions of the stone:—Height from ground, 4 ft. 8 in.; breadth at ground, 22½ in.; breadth near top, 17 in.; at top, about 10 in.; thickness of stone at ground, 9 in.; and at top, about 3½ or 4 in. The inscription, of which I have made a rubbing, is singularly perfect—there being none covered in the ground, and none lost at the top, although it occurs on a rough corner of the stone. I have examined the top several times during my stay; and I may say that I am certain the inscription never extended farther than the four strokes at the right-hand side. I have made a rough, but accurate, diagram copy of the inscription, which may serve as a key to the rubbing; but I regret much that I was not able to make a sketch of the whole monument. There is no

cross on either side of the stone. The stones forming the Caher in which this Ogham monument stands are laid hori-

zontally; but the whole work has a rude and ancient appearance. The interior is much higher than the stone facing. At the Ballywiheen side is a long pile of stones which looks like a large grave; but it seems to form part of the remains of an old fence which runs out in an angular form from this side of the Caher, and may have been part of an ancient enclosure. The pile of stones in question is, however, much higher than any other part of the fence, and seems to have been raised with some care. It was with much regret I parted from Cahernagat and its beautiful Ogham stone,—evening and delicate health having forced me away from a place where I could remain for days.

"Two or three fields north of Cahernagat is another, but much larger enclosure, of a different class—a *Callwragh*—in which may be seen the ruins of an ancient oratory, together with numerous monumental stones and graves, and in the dry wall outside the enclosure, sunk in the ground, is the rudest, and perhaps one of the largest, stone crosses I have ever seen. Mr. Goodman having made an examination of a few of the graves, found in one of them a number of curious natural objects, which must have been brought some distance off, mostly from the sea-shore."

George Petrie, LL. D., read the following notice on some Roman Coins lately found near Rathfarnham, and presented to the Academy by Mr. R. Glennon.

"It may be in the recollection of the Academy that I have on various occasions drawn their attention to the facts of frequent discoveries of Roman, Carthaginian, and other ancient coins having taken place in Ireland, and that on those occasions I expressed my opinion that it was desirable to preserve, when practicable, such coins in our National Museum, and to record the places and times of their discovery. Such has been the course pursued by the Antiquarian Society of Denmark, which boasts the Sovereign as their President. The Royal Society of Copenhagen can now boast of a large collection of ancient foreign coins found in Denmark, and deposited in their National Museum; and the results have been of great interest and historical value. I regret, however, to be constrained to say that as yet we have done very little in this way, or indeed even in endeavouring to make the valuable collection of our own ancient coins which we possess, and which was the gathering of an individual of our body, a more perfect one. And hence it is that I have now availed myself of the opportunity afforded me of again drawing the attention of the Academy to this subject, on the occasion of having to present to our mu-

seum a few ancient Roman coins, recently found in the vicinity of our city.

"These coins were found by a person digging in, or adjacent to, the grounds of a gentleman's place called Fonthill Abbey, situated a little to the south of the village of Rathfarnham; and they were given by the finder to Mr. Glennon, of Suffolk-street, who brought them to me as objects which I might consider of some interest, and accept as a token of personal regard. Perceiving, however, at a glance what the coins were, I deemed it desirable that they should be placed in our own Museum; and, at my request, Mr. Glennon unhesitatingly acceded to me the privilege of presenting them to the Academy in his name.

"It may be further remembered that, in my former remarks upon the frequency of such discoveries in Ireland, I had occasion, more than once, to direct attention to the somewhat curious fact of the finding of Roman coins at or in the immediate neighbourhood of this particular locality. But though this fact was interesting, there was nothing in it of striking importance—nothing that could not be, at least plausibly, accounted for. The coins so found, with one exception, were either coins of the early emperors, or, as more frequently, of those posterior to the establishment of Christianity by Constantine; and in either case it might fairly be conjectured that such coins had been brought into this country by merchants trafficking with Roman Britain or Gaul; or by the marauding Scots who so frequently warred with the Romans in the present Scotland; or, again, by Roman Christians who may have sought a refuge in Ireland from Pagan persecution. But such conjectures cannot be indulged in to account for the discovery of the coins I have now to present to the Academy; for though they are Roman, they are not of the class previously noticed: they belong not to the times of the Empire, but to those of the Republic;—in short, they present us with specimens of the *as*, and some of its subdivisions or parts, all of which appear to be

of a contemporaneous period. In the few remarks which I have to make on these coins I have nothing new to offer—nothing respecting them which is not familiar to most, if not all of my hearers: yet perhaps it may be desirable that I should call up in their recollections a few of the most characteristic features of their type, and one or two of the principal facts respecting their history.

"From the ordinary works on Roman coins and Roman antiquities we learn that, as far as known, the as, æs, or piece of brass, which was originally of a pound weight, and hence called as libralis, is stamped or impressed with the two-faced head of Janus on one side, and, as a symbol of his arriving in Italy by sea, the prow of a ship on the other. The semis, semissis or half, is marked with the letter S, and has usually the head of Jupiter laureated.

"The triens or third has the head of Minerva, and is marked with four round knobs, as being originally of the weight of four ounces.

"The quadrans or quarter has the head of Hercules wrapt in the lion's skin; and has three knobs.

"The sextans or sixth has the head of Mercury with the cap and wings, and has two knobs or discs.

"I should perhaps add, that there was a still smaller division of the as, called unica; it bears the head of Rome, and is marked with a single knob or disc: but of this no specimen was found, or at least preserved. In truth, a coin of this kind, if of a contemporary age with those found, would be so small as to be unlikely to attract notice.

"I should further observe, that the as and its parts were, as in some, if not all, the specimens now brought under notice, originally all cast, not struck; but in time the smaller divisions were struck, though the larger continued to be cast till the as fell to two ounces, or, as in the specimen before us, a single ounce; and they were all of copper, and usually marked with the word *Roma*.

"It only remains for me to say a few words in reference to the probable era of these coins, and this, fortunately, is a point which can be determined with sufficient certainty by an examination of their several weights. As I have already remarked, the as was originally of a pound weight, and its parts were, of course, in relative proportions. But, according to Pliny, in the first Punic war, A. C. 264, on account of the scarcity of money, ases were struck weighing only the sixth part of a pound or two ounces; and he regards this as the first reduction of the as in its weight. This opinion or statement of Pliny's is, however, regarded as an error both by Niebuhr and Pinkerton, the latter of whom, on this point, thus expresses his opinion:—

"'If we trust Pliny,' Pinkerton observes, 'the as continued of a pound weight till the first Punic war, when the necessity of the Roman affairs forced the State to reduce it at once from a pound weight to two ounces. But this account, which is indeed improbable in itself, is confuted by the coins which remain: for we find ases and their parts of all weights, from the pound downwards to Pliny's two ounces. The as must, therefore, have gradually diminished to ten ounces, to eight, to six, to four: and when the size was so much reduced, still more gradual diminutions must have taken place, to three, to two ounces. One or two of the pieces which remain might even imply that the decrease was more slow, to eleven, to ten, to nine, &c.'—*Essay on Medals*, vol. i. p. 126–7.

"Pliny further informs us that during the second Punic war, while Fabius was Dictator, about 215 years before our era, the ases were further reduced in weight to one ounce; and that afterwards, by the law of Papirius Turdus, who was Tribune of the people about 175 years before Christ, it was reduced to half an ounce, at which weight it continued till Pliny's time.

"Finding, then, that the as among these coins is about an ounce in weight, and that the lesser coins are in just relative pro-

portions with it, we are authorized, as I think, to infer that they were all minted between the years 214 and 175 before our era, or, in other words, that they are about two thousand years old."

DONATIONS.

1. Five Roman coins found near Rathfarnham. Presented by Geo. Petrie, LL. D., on the part of Mr. Richard Glennon.

2. A small group carved out of white stone, probably intended to represent the Virgin and Child. Presented by John Rorke, Esq.

3. The number of the Dublin Satirist for March, 1810, containing a letter on the then state and prospects of the Royal Irish Academy, by "A Member" and F. R. S. Presented by Joseph Huband Smith, Esq.

4. Dr. R. R. Madden, on the part of Andrew O'Reilly, Esq., of Paris, presented to the Museum of the Academy the sword of the late Colonel (Jules) Terence O'Reilly, in the French service, as a memorial of the man and the corps to which he belonged; by whom the traditional reputation of Irishmen for gallantry and bravery in the French army was maintained to the last moment of the existence of the Irish Legion.

In connexion with this last donation, Mr. A. O'Reilly has forwarded the following notice of his relative, Col. O'Reilly.

"He was born in Dublin 4th November, 1783, and entered the Irish Legion in the service of France, afterwards the 3rd foreign Regiment, on the 21st Nivose, an. 12, (11 Jan., 1804). He was promoted provisionally to the rank of captain, Aug. 10, 1809, and confirmed in this rank March 4, 1810; and on March 15, 1814, he was appointed chef de bataillon in the 101st regiment of the line, and confirmed in this rank by Louis XVIII. June 15, 1814, and placed on half-pay, being noted for Buonapartism.

"After Napoleon's return to France we find Mr. O'Reilly aide-de-camp of General Loison, at Ligny, Quatre Bras, and

Waterloo. He was also at the defence of Chalons, and in 'The Army of the Loire:' the last force that remained faithful to Napoleon, up to its dissolution in the autumn of 1815.

"From 1804 to 1806 Mr. O'Reilly was at Brest and elsewhere on the coast of Brittany.

"From 1806 to 1807 he was with the armies of Reserve at Mayence.

"From 1807 to 1808 he was with the Army of Observation on the Scheldt.

"From 1808 to 1809 he was with the army of Walcheren.

"In 1811 he was with the army of the Scheldt.

"In 1812 he was with the Army of Observation in Holland.

"In 1813–14 he was with the Grand Army in Germany, &c.

"He had thus more than eleven years of active service, and nine campaigns in the French army.

"In the Walcheren campaign, and especially at Flushing, in resistance to the British army under Lord Chatham, Col. O'Reilly distinguished himself with Col. (afterwards General) William Lawless; he saved the eagle of the Irish regiment. It was on this occasion that he was promoted to the rank of captain, and distinguished by the cross of the Legion of Honour. The Emperor also ordered that in future the arms, &c. of the regiment should have impressed upon them an ensign bearing a flag, with the word 'Flessingue' inscribed upon it, which we find on the blade of the sword now presented to the Academy."

MONDAY, JANUARY 12TH, 1857.

JAMES HENTHORN TODD, D. D. PRESIDENT, in the Chair.

JOHN ROBERT KINAHAN, M. B., was elected a Member of the Academy.

The Secretary of the Council read the following recommendation of the Council:—

"That the Executive Committee for conducting the Exhibition of Art-Treasures at Manchester be permitted to make a selection (subject to the approval of the Council) from the Celtic Antiquities in the Museum, provided they comply with the conditions which the Council shall determine."

A division having been called for, the President declared that the recommendation of the Council had been negatived.

The Rev. William Reeves, D.D., read a paper on the early system of abbatial succession in the Irish monasteries. The cases which were chosen in illustration were the churches of Trim, Armagh, and Hy or Iona. Concerning the first, the Book of Armagh* contains, among some fragmentary charters of the See of Armagh, a most interesting record relative to the foundation and endowment of Trim. It gives a list of the first eight abbots of that church, all anterior to the earliest entry under that head in the Irish annals;† and of them it observes: "*Hi omnes episcopi fuerunt et principes, venerantes sanctum Patricium et successores ejus.*" It also gives a lineal pedigree of the family which sprung from the original grantor of the lands, out of which the ministers of the church were

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* Penes Scriptorem; fol. 16 *a b*.

† The earliest entry concerning an abbot of Trim, in the Annals of Ulster, is 745, which the Four Masters transfer to their 741.

elected. The former is styled the *Ecclesiastica progenies*, the latter, the *Plebilis progenies*, of the founder. This record was written about the year 720, and is copied into a manuscript which was executed about the year 807. This document, which is of undoubted authenticity, serves as a most valuable key to the early system of endowment in the Irish Church, and it helps also to account for the rapid growth of the Irish monasteries, and the territorial jurisdiction which they acquired. It may yet be found that the civil condition of this country was, in the fifth and sixth centuries, in a very disordered state, and that the *immolatio*, or mortifying, possessions by a chief, under such tenor as "To Patrick, Loman, and Fortchern, his (the grantor's) son, until the day of judgment," introduced an element of fixity in tenure of land, which was likely to prove very acceptable in a country where the succession to property was so ill-defined, and property itself so little available to the uses of life. In such case, the grant was made to the great missionary of Ireland as virtual Primate, with limitation, *pro hac vice*, to the minister locally employed by him, and remainder to the family of the son in whose name, or by whom, the grant was made. Hence we find the *Plebilis progenies*, in whom the tenancy of the lands was vested, possessing a regular succession, and furnishing from its members certain *coarbs*, or successors, to the first abbot, who formed the *Ecclesiastica progenies*, and who, being unmarried, exhibit no lineal succession. In fact, the rule was, on each avoidance of the abbacy, to fill up the situation from founder's kin; and, failing a qualified person in the direct line, to choose a successor from a collateral branch. But in process of time, when discipline became lax, and endowments more valuable, it would seem that the *Ecclesiastica progenies* merged in the *Plebilis progenies*, which might easily occur, from a disinclination on the part of the latter to allow the dignity and emoluments to leave their own hands. In such case the tenant in possession probably assumed holy orders

himself, and united in his person the exercise of the religious functions, and the enjoyment of the possessions, of which he was, according to precedent, only the trustee or farmer. The lineal transmission of the abbatial office in various monasteries, which appears in the Irish Annals from the close of the eighth century onwards, had its origin in the usurpation by the *Plebilis progenies*, in the several monasteries, of the functions of the *Ecclesiastica progenies*, which would be the necessary result of the hereditary occupants omitting to keep up the purely spiritual succession. It was this consolidation of spirituals and temporals, no doubt, which led to the existence of the *Abbates laici*, of whom Giraldus Cambrensis* speaks as existing in Ireland and Wales. Hence, also, grew that melancholy misappropriation of the endowments of Bangor, of which St. Bernard † so feelingly writes, and of the proportionate declension of the religious character of that once-famed monastery. Hence, too, in a measure, the anomalies in the case of Armagh, on which the same writer dwells in terms of such heartfelt reprobation.‡

With respect to Armagh, that church was situate in the territory of the descendants of Colla-da-chrioch, one of the founders of the Oirghialla, or Oriel race. Daire, who granted the site to St. Patrick, was of this tribe, and many of the early abbots or bishops of the church were, from the fifth to the eighth centuries, members of the Hy-Bresail, and Hy-Niallain families, which derived their names from descendants of Colla-da-chrioch, and left their designation stamped on the districts which they occupied, still preserved in the forms O'Bresail and Oneilland, the latter of which is known as a barony in the county of Armagh. Subsequently, another descendant of Colla, named Sinach, founded a family, called from him the *Clann*

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* Itinerarium Cambriæ, ii. 4.

† Vita S. Malachiæ, cap. 5 (Messingham, Florileg., p. 356).

‡ Ibid., cap.7 (Messingham, pp. 358 *b*, 359).

Sinaich, and to this family the enjoyment of the abbacy of Armagh, styled the "coarbship of St. Patrick," became limited; so that for a space of about two centuries it never left it, and had entailed so many abuses and relaxations of discipline, that St. Bernard, with justice, made the following complaint:—"Verùm mos pessimus inoleverat quorundam diabolica ambitione potentum sedem sanctam obtentum iri hæreditaria successione. Nec enim patiebantur Episcopari, nisi qui essent de tribu et familia sua. Nec parum processerat execranda successio, decursis jam hac malitia quasi generationibus quindecim. Et eò usque firmaverunt sibi jus pravum, imo omni morte puniendam injuriam generatio mala et adultera, ut etsi interdum defecissent clerici de sanguine illo, sed Episcopi nunquam. Denique jam octo extiterant ante Celsum viri uxorati et absque ordinibus, literati tamen."* This "Celsus" was *Cellach* of the Irish, who was abbot from 1106 to 1127. From the pedigrees of the Clann Sinaich, preserved in the Books of Lecan and of MacFirbis, illustrated by the details and chronology of the Irish Annals, we are able to construct a genealogical table of the abbots of Armagh, which answers, with wonderful exactness, to the statements of St. Bernard, founded, as they were, upon the information furnished to him by Malachi O'Morgair, and the abbot Congan.

The abbey of Hy, or Iona, was founded by St. Columba, great-grandson of Conall Gulban, the head of the Cinel Conaill, or great Donegal race. St. Columba died in 597, and was succeeded by his first cousin, Baithene, who died in 600; Laisre, the third abbot; Fergna, the fourth; Segine, the fifth; Cumine, the seventh; Failbhe, the eighth; Adamnan, the ninth; Donnchadh, the eleventh; Faelcu, the twelfth; Slebhine, the fifteenth; were all of the same race, so that during a period of two hundred years there are but three abbots whose descent is ostensibly referable to another stock;

* Vita S. Malachiæ, cap. 7 (Messingham, Florileg., p. 358 *b*).

thus showing that, even in spiritual administration, the element of clanship regulated the bestowal of authority, and that the election of the religious superior was subject, among the Irish, to qualifications of blood, similar to those which constituted eligibility to secular chieftainship.*

Dr. Petrie stated, that in 1832 he had made an analysis of the monumental inscriptions at Clonmacnoise, which proved that the ecclesiastical successions at that Abbey were continued amongst persons of the family of Malone for several hundred years.

DONATIONS.

1. A collection of twenty-nine heel-ball rubbings, taken by Mr. Du Noyer from monuments and inscriptions in different parts of Ireland. Presented by George Du Noyer, Esq.

2. Three bronze brooches; four large beads; and an ornament with pendants in silver, collected by Mr. Jennings at Mogadore, in Africa. Presented by Francis M. Jennings, Esq.

The Secretary of the Academy read a letter from Mrs. Hitchcock, explaining that it was the last wish of her husband, the late Mr. Richard Hitchcock, that his books should be presented to the Royal Irish Academy.

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* The reader who is curious on this subject will find the question treated of in the Life of St. Columba, lately published by the Irish Archæological and Celtic Society, p. 342; where there is a Genealogical Table of the early abbots of Hy, constructed from the pedigrees in the Book of Lecan.

Monday, January 26th, 1857.

JAMES HENTHORN TODD, D. D., President, in the Chair.

In the absence of the author, the President read a paper, by the Rev. Dr. Reeves, "on the Irish Abbey of Honau on the Rhine."

"It is very well known that numerous xenodochia, or hospitals, were founded, in the seventh and following centuries, by the Scots, in various parts of Europe for the benefit of their countrymen; and, although, an adverse claim was put in by the Scotch, about 250 years ago, it is now almost universally acknowledged that Ireland was the fatherland of the Scots.

"In the year 845, the Council of Meaux* passed a decree concerning the restitution of the hospitals of the Scots, which holy men of that race had built in the same kingdom for the reception of pilgrims belonging to their nation.

"Such an hospital was the monastery of Honau in Lower Alsace, a short way north-east of Strasbourg, situate on a level tract at the east side of the Rhine, in a bend of that river, and insulated by a minor channel, which leaves and re-enters the main river on the south and north. The history of this institution is gathered from a collection of fourteen charters, which were communicated to Mabillon† by John le Laboureur, a canon of St. Peter's, the old, of Strasbourg,‡ who had transcribed them diligently from a vellum MS. of the year 1079, into which they had been carefully copied by Leo, a canon of Honau.§

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* Concil. Meldens., Can. 40. (Hardouin, *Concilia*, tom. iv. col. 1490.)

† Printed in his Annales Ord. S. Benedicti, tom. ii. Append. pp. 695 *b*-700 *a*.

‡ The college of Honau had been transferred to this church.

§ Annal. Ord. S. Bened., tom. ii. p. 59.

"The monastery of Honau, called in Latin records *Honaugia* and *Hohenaugia*,* was founded, a little before the year 720, in honour of St. Michael the Archaugel, by an Irish Bishop called Tubanus, who was also known by the title of Abbot Benedict. Thirty years later, a Bishop Dubanus is spoken of in some of the charters as the then abbot, and although Mabillon regards him as a successor,† he may possibly have been the same individual. The commutability of T and D among the Irish plainly refers Tuban and Duban to the same source. The Irish Calendars have two commemorations of presbyters of the name, one at Februrry 11, and the other at November 11. The former was of British extraction, and flourished in the early part of the sixth century. He was patron saint of the church of *Rinn-Dubhain*,‡ or 'Dubhan's promontory,' known now as *the Point of Hook*, at the extreme south of the county of Wexford, on the east side of Waterford Harbour. The word *Hook* is the supposed translation of Ꝺuƀan, which commonly signifies a 'fishing-hook.' The original name, however, is locally preserved in 'St. Duffin's Well,' which the Ordnance Survey marks at this place.§ Dr. O'Donovan‖ interprets *Dubhan* by *Nigellus*,¶ as if a diminution of *Dubh*, but to this is opposed the entry in the Tripartite Life of St. Patrick,** which mentions *Dubdubanus*†† as the first minister of

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* That is, *Hohenau*, "High-meadow."

† So Jodoc Coccius, Dagobert, 133; Zeuss, Gram. Celt., i., Præf. p. xviii.

‡ See Colgan, Acta Sanctorum, p. 314; and Calendar of Donegal, Nov. 11.

§ Maps of the County of Wexford, Sheet 54.

‖ Proceedings, &c., of the Kilkenny Archæol. Soc., vol. iii. p. 198.

¶ So also Zeuss, Gram. Celt., Præf. p. xviii., who takes Tubanus to be different from Dubanus.

** Lib. ii. c. 114, Trias. Thaum., p. 144 *b*. "Cui unum e discipulis Dubdubanum, Corcani filium, præfecit."

†† We find a Donndubhan, son of Imhar of Waterford, in the Four Masters, A.D. 995. Ua Dubhain, ib. 952. Dubhan appears in the pedigrees of the house of Cormac Gulban, as father of St. Dubthach, Feb. 5.

the church of Domhnach-mor of Mogh-Itha, now Donaghmore in the barony of Raphoe. The word 'Dubh' would hardly be prefixed to its own diminutive.

"Of the other Dubhan the priest, the Calendar gives no further information than his day. He may be the Cpuımċep Ouḃaın, of the Naemhsenchas in the Book of Lecan.

"The Dubhan of Honau, however, was of a totally different age and order; and these instances are merely adduced to prove the Irish character of the Latinized name *Tubanus* or *Dubanus*.

"The site and endowment of the monastery of Honau were granted to Benedict, otherwise Tuban, by Adalbert, Duke of Alsace, and they were subsequently augmented by successive members of his family, as appears from the following abstract of the charters printed by Mabillon:—

"I. In June, 724, Boronus, son of Bothelo, Adalbert's brother, assigns to the monastery of Honaugia on the Rhine that portion of the island which he had inherited from his father. Also a holding in Gwllistet occupied by Bobo.*

"II. September, same year, Häicho, brother of Duke Adalbert, made an additional grant of his portion of the lands in the island of Hohenaugia.†

"III. December, same year, Liutfrid and Eberhard, sons of the Duke Adalbert, made a similar grant of the lands in the island of Hohenaug, which their father had left to them. Hence it appears that the founder was dead in 724.‡

"IV. April, 749,§ Boronus (the Boronus of Charter I.)

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* Mabillon, Annal., tom. ii. Append. p. 695 *a*.

† Ibid., p. 696 *a*. ‡ Ibid., p. 696 *a*.

§ The date is, An. vi. Hilderici regis. This was Childeric, the last of the Merovingian Kings. He was saluted King by Carloman and Pippin in 743. With respect to his paternity, Mabillon contradicts himself, for here he calls him "son and successor of Theoderic" Calensis, namely IV. (p. 59), but at p. 103 he says:—"This king left *no children*;" and at p. 121 makes Childeric son of Chilperic.

granted to the monastery of St. Michael the Archangel, on the island of Hohenaug,—'ubi in Dei nomine Dubanus episcopus præesse videtur,' certain lands in Joabbagine and Nuziviert, together with their appurtenances.*

"V. May, same year, Hugo, son of Bleon, nephew of Duke Adalbert, granted to the monastery in the island called Hohenaugia,—'ubi Dubanus episcopus nunc temporis præesse videtur,' all that portion of the island which he had inherited from his father.†

"VI. October, 750, Bodalus, son of the preceding, granted to the monastery on the island called Hohenaugia,—'ubi in Dei nomine Dubanus abbas præesse videtur,' all his possessions in the said island. This is the last grant made by the family of Duke Adalbert.‡

"VII. In an undated charter, but circ. 755, Pippin, King of the Franks, at the prayer of Dubanus,—'episcopus vel abbas de monasterio Hohenaugia in pago Alsacense,' confirmed to him all and sundry his possessions, whether royal grants, donations of subjects, acquisitions of antecedent abbots, or the augmentations which had been made by the same Dubanus, bishop or abbot, and were now enjoyed by him.§

"VIII. March, 770, Carloman, son of Pippin, at the prayer of the abbot Stephen, exempted the monastery on the island of Honaugia from all judicial intrusion or interference.||

"IX. January, 783, Charlemagne, at the prayer of the Abbot Beatus, confirmed the preceding grant.¶

"X. June, 786, Charlemagne granted a confirmation of all the donations antecedently made to the monastery by kings, queens, or other servants of God, but of which, through neglect, the charters had some years before been lost. In it

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* Mabillon, Annal., tom. ii. Append. p. 696 *b*.

† Ibid., pp. 696 *b*; 697 *a*. ‡ Ibid., p. 697 *a*. § Ibid., pp. 697 *a*; 697 *b*.

|| Ibid., p. 698 *a*. ¶ Ibid., pp. 698 *a*; 698 *b*.

he makes mention of 'Beatus, abbas ex monasterio *Scotorum*, quod vocatur Honaugia, quod Benedictus episcopus in honore sancti Michaelis novo construxit opere, ubi ipse venerabilis pater corpore requiescit.' In the course of the charter he styles the monastery 'casa Dei,' and 'ecclesia sancti Loci.'*

"XI. October, 787, Charlemagne, on the petition of 'Beatus abbas, qui est rector monasterii Hohenaugiæ,' granted a charter, exempting the monastery from tolls and other imposts.†

"XII. An undated charter of Charlemagne, 'commendat omnibus qui acceperunt aliquid de ecclesia Scotorum, quæ est in insula Honaugia, ut iterum reddat omne quod accepit, vel quod rapuit sine licentia abbatis Beati: et si quis retentat parum, commendat omnibus judicibus terræ illius, ut illi quærant omnes res ecclesiæ cum ratione secundum Legem Francorum, quia res peregrinorum propriæ sunt Regis. Ideo restaurentur omnia illa prædicta ad ecclesiam *Scotorum* sive ullo impedimento, sive terra, sive vinea, sive pecunia, sive homines, sive argentum, sive aurum. Si quis unum hoc non fecerit, recognoscat se regis præceptum non obaudire: quia *Reges Francorum libertatem dederunt omnibus peregrinis Scotorum, ut nullus rapiat aliquid de rebus eorum, nec ulla generatio* præter eorum generationem possideat ecclesias eorum.'‡ This is an exceedingly interesting record of the high esteem and favour in which the Irish of the Continent were held at that time by the greatest monarch of the west.

"XIII. An undated instrument of Charlemagne, in which he formally adjudicates to Adalbert or Odbert, advocate of St. Michael's of Honaugia, or Beatus the Abbot, those lands in Vestiva and Gefida which had been occupied and now claimed by the monastery of Corbie in Picardy.§

"XIV. The closing charter contains the donation of the

* Mabillon, Annal., tom. ii. Append. p. 698 *b*.

† Ibid., 699 *a*. ‡ Ibid , p. 699 *a*. § Ibid., p. 699 *b*.

abbot Beatus to his monastery, and, being much the most important, in a literary point of view, it is given here in full:—'Sacrosanctæ ecclesiæ, quæ est constructa in insula, quæ publice ab omnibus Hohenaugia nominatur, super fluvium Rhenum in honore S. Michaelis archangeli, ceterorumque sanctorum.* Ego itaque Beatus, etsi indignus abbas, dono pro animæ meæ remedio totum et integrum, quantumcumque acquisivi aut collaboravi, aut etiam per manus bonorum hominum et per chartas firmas inveni, et per chartam confirmationis regis Caroli et imperatoris. Dono autem hoc totum et integrum, ad illum locum prædictum et ad illos sanctos, in quorum honore constructus est, et *ad pauperes et peregrinos gentis Scotorum*. Dono autem hoc totum, ut ille abbas, *quem ego elegero secundum regulam ecclesiasticam*, post obitum meam habeat. Dono autem primum ecclesiam, quam ego construxi in *Magontina civitate*; et alteram ecclesiam, quæ est constructa in *Sylvia* in Marchlichio; et etiam ecclesiam *Lognaw* in curte nuncupata *Wisicha*; et quartam, quæ est in *Hawenbach*; et quintam, quæ est in *Bunenheim*;† et sextam, quæ est in *Rhodaheim*;‡ et septimam, quæ est in *Hurmusa*; et octavam, quæ est in *Buchonia*; cum omni adjacentia, trado atque transfundo, et in perpetuum ut permaneat volo tam terris, campis, pratis, silvis, vineis, domibus, ædificiis, peculiis utriusque sexus, mancipiis, aquis, aquarumve discursibus, mobilibus, et immobilibus; in hac vero conditione, ut ab illo die transitus mei, ipse abbas loci illius, cui ego commendavero, habeat potestatem habendi, possidendi, commutandi, aut quicquid ex illa re regulariter et ecclesiastice facere voluerit. Si quis vero, quod fieri non credo, contra hanc chartam confirmationis et oblationis venire tentaverit, aut irrumpere voluerit; primitus iram Dei incurrat, et de illa ecclesia velut

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* Here another copy, cited by Mabillon at p. 392, adds, "*numero centum quadraginta-octo*," a form very like some of the commemorations in the Litany of Ængus the Culdee.

† Bubenheim.

‡ Rodesheim.

extraneus abjiciatur, et insuper ista confirmatio firma permaneat. Ego Wellimannus rogatus scripsi et notavi diem et tempus et locum. Hæc charta in Maguntia civitate scripta xi. Kal. Julias, anno x. regni domini nostri Caroli regis et imperatoris.

"'✠ Signum Beati abbatis, qui hanc chartam fieri rogavit.
✠ Signum Comgani episcopi.
✠ Signum Echoch episcopi.
✠ Signum Suathar episcopi.
✠ Signum Maucumgib episcopi.
✠ Signum Caincomrihc episcopi.
✠ Signum Doilgusso episcopi.
✠ Signum Erdomnach episcopi.
✠ Signum Hemeni presbyteri.'*

"In the above charter we find the Abbot Beatus, whose influence was probably owing to the favour and patronage of Charlemagne, as expressed in the twelfth charter, granting all that he himself had acquired or laboriously put together; also claiming the right of nominating his successor in the monastery, agreeably to ecclesiastical rule, a power which St. Columba, and other founders, or restorers, exercised in Ireland.

"The *eight* tributary churches, the first of which was founded by the Abbot Beatus himself, in Mentz, or Mayence, prove the extended jurisdiction of this monastery; and it is a curious fact, that there are just *eight* subscriptions to the charter, besides that of Beatus, each probably representing the minister of an affiliated church. Some of these eight churches, probably all, are situate in the Palatinate of the Rhine, and lay near Mentz, on the south side of the Rhine. Hawenbach is now *Hauenbach*; Bunenheim is the modern *Bubenheim*; Rhodaheim is now *Rodesheim*; Buchonia is probably *Bokenn* or *Bockenheim*.

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* Mabillon, Annal., Append. pp. 699 *b*; 700 *a*.

"Their ministers, as their names indicate, were all Irishmen. Mabillon observed this fact, and says:—'Ejus litteris subscribunt septem episcopi, quos omnes Scottos fuisse barbara eorum nomina satis arguunt.'*

"They are truly Scots, but their names are not 'barbarous;' at least we, who find most of them in our records, and know how to pronounce them, do not think so. We would call Moguntiacum a very barbarous name; but when we see it in the German form of Mentz, or the French Mayence, we are more favourably disposed towards it.

"I shall now examine these subscribing names *seriatim*.

"1. BEATUS.—The abbot's name is manifestly an ecclesiastical one, as that of the founder, Benedict for Dubhan; and if it follows the rule of domestic exchange, it is a Latinized form of Beoaedh, or Beoan.† This custom of exchanging native for Latin or Germanized names has disguised many of the Irish missionaries on the Continent, and renders the Irish origin of some undoubted Scots, as, for instance, Disibod and Fridolin, so questionable to the minds of some.

"2. COMGANUS.—A name found in the Calendar of Donegal, at Feb. 27, Aug. 2, Oct. 13; in the Annals of the Four Masters at the year 868. An abbot of this name, in the form *Conganus*, is mentioned by St. Bernard.‡ Mabillon reads *Conigani*, but the *m* is evidently dissected by him.

"3. ECHOCH.—The old genitive of Eochaidh, here governed by *signum*. The common form of this genitive in our early pedigrees is *Echach*.

"4. SUATHAR.—A rare name, for which Suadhbhar of the Four Masters, A. D. 889, is probably a parallel.

"5. MAUCUMGIB.—There is no parallel for this name in

* Annales Ord. S. Bened., tom. ii. p. 59.

† See Colgan, Trias Thaumaturga, p. 181 *b*, n. 188; Acta Sanctor., p. 562.

‡ Vita S. Malachiæ, Præfat. (Messingham, Florilegium, p. 351).

our domestic records, and it is, most probably, a misreading of the original.

"Zeuss calls the present form, 'monstrum falsa lectione ortum, nec hibernicum, nec germanicum nomen;'* and proposes *Mailbrigte;* but the remedy is worse than the disease.'

"6. CAINCOMHRIC.—In the form Caencomhrac it is found in the Annals of the Four Masters, at 786, 834, 898, 927, 936, 941, 945, 952, 961, 986, always borne by ecclesiastics. Mabillon incorrectly reads *Canicomrihc.*

"7. DOILGUSSO.—The old genitive of Doilgus, which Zeuss takes to be an error for Dongus, a name found in the Irish Priscian at St. Gall.† But such emendation is unnecessary, as we find the name itself in our Annals. The Four Masters, at 750, record the obit of *Daelgus*, abbot of Cill-Scire; which is copied from the Annals of Ulster, 754, where the name occurs in the older form *Doelgus*.

"8. ERDOMNACH.—A phonetic form of ꝑeᵹnoomnach, a name very common among the Irish, and particularly notable in the case of the scribe who wrote the Book of Armagh, and of the Abbot of Clonmacnoise, who died in 870, and whose tombstone is drawn by Dr. Graves in the Proceedings of this Academy.‡

"9. HEMENUS.—An aspirated Latin form of Emhin, of which instances occur in the Calendars at Jan. 7, Dec. 18, Dec. 22; in the last case, as Bishop of Ros-glas in Ui-Failghe, now called from him, Monaster-Eimhin, or Monasterevan, in the county of Kildare.

"Another indication of the Irish connexion of these subscribing witnesses is the remarkable fact of all, except two, being bishops, and one of the exceptions being the superior of all, the Abbot Beatus, who signs first, and styles himself simply *abbas;* a state of ecclesiastical precedence so like that of

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* Gram. Celt., vol. i., Præf. p. xviii.

† Ibid., vol. i., Præf. pp. xvi. xviii.

‡ Vol. iii. p. 322.

Hy and other Irish monasteries,* where bishops were often subject to presbyters, and abbatial rank was the grand criterion of jurisdiction. In the present case, the existence of one or two bishops among the early abbots of Honau led some writers to suppose that this church was formerly diocesan; but Mabillon, who instances the parallel case of Laubes, in the diocese of Cambray, justly observes :—'Somniantur proinde qui episcopalem Honaugiæ sedcm eo tempore institutam putant.'†

"Jodoc Coccius enumerates the abbots of Honau in this order :‡—1. Benedict, or Tubanus; 2. Dubanus; 3. Thomas; 4. Stephanus; 5. Beatus. In the ninth century the monastery adopted the order of Secular Canons, when Charles the Gross confirmed its possessions. In a subsequent age the College of Canons was transferred to Strasbourg, to the older Church of St. Peter."§

* See the case of Hy examined in detail in the Life of St. Columba, lately published by the Irish Archæological and Celtic Society, p. 340.

† Annales Ord. S. Bened., tom. ii. p. 59.

‡ Dagobert, p. 133.

§ Mabillon, ibid., p. 60.

MONDAY, FEBRUARY 9TH, 1857.

JAMES HENTHORN TODD, D.D., PRESIDENT, in the Chair.

ROBERT M'DONNELL, Esq., M.B., and Frederick Field, Esq., were elected Members of the Academy.

Sir William R. Hamilton read a paper on the Icosian Calculus.

Mr. J. M. Kemble, at the request of the President, delivered an Address on the utility of antiquarian collections in relation to the pre-historic annals of the different countries of Europe, with especial reference to the Museum of the Academy.

"DR. TODD, AND GENTLEMEN OF THE ROYAL IRISH ACADEMY,—I should be guilty of great affectation were I to pretend that I thought what I mean to say was entirely devoid of novelty and interest to you. It is, in fact, mainly on account of the extensive opportunities which I have enjoyed of seeing what is new to many of us in the various European collections, that I am this evening called upon to address you. Nor can I venture to plead that I am not in the habit of putting forward my views in public whenever it appears to me desirable for our common study that it should be done; but still, I may justly say, that I never rose under feelings of greater embarrassment than at present, to address any academical body. I feel abashed at the extent of the subject itself with which I have to deal, and painfully aware how small a part of it I can treat of with satisfaction, either to yourselves or myself, within the limits of one short evening. I am not the less painfully aware that I am addressing a body of gentlemen who have bestowed great zeal and labour upon this subject, and whose

names are honourably recorded wherever their labours have been made known. But there is another and special subject of embarrassment peculiar to myself. It is well known to me that a learned friend and colleague of mine has on a former occasion been called upon to address you with regard to the Collection of the Royal Irish Academy, and that the opinions which he on that occasion gave utterance to were put upon record, and circulated to a certain extent with the authority of the Academy itself, from appearing in one of their publications. I regret to say, that I hold very different opinions from my friend Dr. Worsaae; and that from the conviction that the adoption of his opinions, and the pushing them to their legitimate consequences, would betray us into grave historical errors, I feel it my duty on this occasion to protest as publicly against them as he himself gave utterance to them. I think anybody who follows the train of thought of the archæologists of Northern Germany, and more especially what that amiable and accomplished scholar, Dr. Lisch, has raised upon the foundations laid by the *savans* of Denmark, will agree with me that those gentlemen are led into a historical *reductio ad absurdum*. I have myself heard Dr. Lisch declare, in the meeting of the Central Archæological Association of Germany held at Dresden, under the presidency of his Majesty the present King of Saxony, that the Germans were totally unacquainted with the use of iron, and that this was first introduced into the provinces of the Baltic by the Sclavonic tribes in the eighth century. Errors like these are hardly to be excused, and are perfectly unintelligible in any classical scholar. Now, I do not deny that there is a great convenience in the division adopted by the *savans* of Denmark, into the products of a Stone, a Bronze, and an Iron period. I believe that this has some foundation in historical truth, and I am perfectly aware of its value in the co-ordination and arrangement of a museum. It is, however, no novelty: the main characteristics of the principle were re-

cognised two centuries ago by Eckhart, the continuator of Leibnitz, and by other eminent German scholars. But the extension of it into a system attempted to be founded upon history is due to the present race of Danish archæologists, and it is to their conclusions, in as far as these are of a special nature, that I refer, and against which I feel bound to enter my public and energetic protest. There is no doubt, Gentlemen, that in the earliest ages of culture, weapons and implements are formed of the rudest materials accessible to man; that he is acquainted with wood, and horn, and stone, before he obtains a sufficient mastery over the metals to convert them to the purposes he desires; and accordingly, we do find implements or weapons both of horn and stone, to the exclusion of the metals, at periods which the lessons of Geology compel us to place at an almost infinite distance from our own. I would remind you only of the operations of the Commissioners for the improvement of the navigation of the river Shannon. The men of science connected with that great undertaking will assure you that the lowest stratum bearing marks of human life contained implements of stone and horn so far below the first appearance of implements of metal as to imply an almost incalculable lapse of centuries between the two deposits. It is true, that the rudeness of those implements has been and is a cause of great difficulty to the archæological inquirer. It has long been found one of the most difficult problems, how these instruments were to be made use of, and it is only of late that discoveries have been made which enable us to form a distinct opinion on the subject. Let me call your attention to some of these rude prisms of flint contained in the cases in the next room. They seemed incapable of being turned to any use; but in excavations of recent date lately made in the valley of the Somme, in strata upwards of twenty feet below the present level of the surface of the earth, in company with the bones of the rhinoceros and other animals extinct in these parts of the world, there have

been found portions of the horns of the elk and of deer belonging also to extinct species, which bear obvious marks of the work of man's hands: and in these we find the explanation we seek.

" Let me call your attention for a moment to the nature of those weapons. They consist for the most part of a portion of stags' horn, from four to six inches in length, bored transversely for the reception of the handle, and at one end, or both, also bored for the reception of a stone point. Accompanying these, and in such a position that there can be no doubt of their having belonged to one another, are not only such prisms of flint as I allude to, but also small flint celts of elaborate workmanship and polish. It is remarkable that the transverse or shaft hole is extremely small, and could have received only a frail handle; but in one instance or in more it has been discovered that the point of the tyne was used for this purpose, and that thus a hammer, small, indeed, in its proportions, but efficient in the absence of defensive armour, was produced; and, indeed, in some cases it is clear that the sharp point of the tyne itself was inserted in the longitudinal opening—thus making a formidable pick, which might be used not only for purposes of peaceful life, but also for purposes of offence. And, unless I have been greatly misinformed, a skull has been exhumed in Sweden in which such a weapon was actually found inserted. The stone edge given to the horn weapon, and which we may suppose to be of somewhat later introduction than the mere sharpened horn itself, was fixed in its place by the use of some cement, the composition of which is at this hour unknown to us.

" The analogy of various savage tribes that armed their weapons with the edge of sharpened sharks' teeth is borne out by the analogy of those bone weapons of the North which occasionally received their edge from the insertion of fitting portions of flint. In the Museum at Copenhagen there is such a spear-head, and there are two knives, of elaborate workman-

ship, in the Royal Museum at Berlin, whose edges are produced by sharpened filaments of flint. I need scarcely remind you that the weapons of the Mexicans were in like manner armed with portions of obsidian. Now, the cases to which I allude are not solitary, but numerous. Upwards of forty have, I believe, been collected in the alluvial tract wherein the waters of the Somme now flow, and in all probability they would be much more numerous had due observation been exercised by collectors. One single instance is, however, known to me as having occurred in the British Islands, and that within a few weeks only. In the tract called Wychwood Forest, in Oxfordshire, the surveyors employed by the Government discovered a rude interment, little below the surface, but which had apparently never been disturbed. Together with pottery, of the oldest description, and bones of various kinds, was found such a portion as I have described of stag's horn, so prepared to receive a cutting edge. Mr. Queckett, of the College of Surgeons, to whom this was shown, investigated it by the aid of a microscope, and declared it to be a portion of the horn of a deer long extinct in England

"Now, Gentlemen, we may fully admit that many implements of stone which are discovered do belong to the earliest period of human culture, and that the analogies upon which the so-called Stone period has been rested are not entirely to be despised; but experience teaches us that the use of stone continued long after those ages passed; and it is consonant to human nature itself that this should be the case. The weapon which, when launched by the hand, is not to return to its owner, may easily be of less valuable material than that which the man looks upon as connected with his own person; and thus the arrow-head of flint may easily have been contemporaneous with the period of Iron. The want of value in the material pointed it out for the manufacture of these articles, the use of which implied their loss. We have the historical evidence of Ammianus Marcellinus that the Huns—a race un-

doubtedly well acquainted with the use of metallic weapons—were universally in the habit of pointing their arrows with sharpened bone.

"But there is another ground, of a general character, for the use of those implements at times very much later than those to which they are attributed in the theory of our Scandinavian friends. The man who finds a weapon of this description, and thinks he can turn it to advantage, is likely enough to do so, without inquiring whether the requirements of a philosophical system will be much disturbed by his act or not. We are aware that at the battle of Hastings, in 1066, the Saxons used battle-mauls made of stone, which they hurled against their adversaries. We know that, even as late as the Thirty-years War, the soldiers of Wallenstein and Tilly, here and there, for want of better implements, used the old stone hammers as efficient weapons of attack. Nay, more, to this day the peasant of Brittany, if, while tending his sheep upon the plains, he discovers one of the polished celts of his forefathers, takes it at once to the neighbouring forest, and there, splitting the branch of a young tree, inserts it, well assured that, in the course of a year or two, the operations of nature will have fixed it with such firmness in the cleft, that he has but to cut the handle, and his axe is ready made to his hand.

"All these are grounds of disturbance, and will render it impossible to apply with strictness the canon of Copenhagen to the characterizing the graves according to their different periods. But there is another and a very strong ground of disturbance.

"Certain races of the world, as it is well known, have attached a strong superstitious feeling to the possession of these ancient stone implements; and when they have found them, they have treasured them as something supernatural. In many parts of Germany, and, as I am informed, in Ireland and Scotland also, they are still looked upon as amulets particularly valuable in the diseases of cattle. The collector

meets with no greater difficulty than that which occasionally arises from the disinclination of the possessor of such a stone to give up what he looks upon as a useful remedy for the sickness of himself and his neighbours; and in many parts of Germany it is strongly believed that these 'donnerkeile,' as they are called, or thunderbolts, are an efficient preservative against lightning. You will see that this is a mere remnant of the old Thor worship amongst the Germanic population. The concurrent testimony of ecclesiastical and secular history proves to us that the Germans attached a superstitious veneration to stones; and I may mention, as the result of my own experience, that these ancient implements were frequently deposited in the cemeteries even of the latest Pagan race, unquestionably upon some notion of holiness attached to them. These stone flakes, which we are agreed to call knives, are never more usual than in the neighbourhood of graves of the Iron period; and one of the surest indications I have had, that I was in the neighbourhood of such a cemetery, was the finding multitudes of those flint chips in the soil about me. On one occasion I remember, after exhuming nearly two hundred urns, containing chains and fibulæ of bronze and iron, I came upon a small cyst, in which were deposited a magnificent hammer-head of black basalt, and one of those flint daggers which, I believe, are unknown in this country, but of which you have a specimen in the collection the King of Denmark sent to the Royal Irish Academy. In a similar way, from the cemetery at Retdorf upwards of ninety urns were taken, furnished with one broken dagger of silex, and with many hundred flint chips, not rarely deposited intentionally around the separate urns themselves. To what race we are to attribute the first construction of these implements, is still a great problem of archæology. All that we can with certainty say is this—that even if constructed in the earliest periods of human culture, they continued, for various reasons, to be used almost until we come to the threshold of historical

times. A good deal of the same reasoning applies to the weapons of bronze, which, as you are well aware, are found not only in all European, but in many Asiatic countries. There is, as far as I can tell, no evidence whatever of bronze having been used on account of the absence of iron, and not much reason to doubt that the two metals were used contemporaneously. At the same time, I would call your attention especially to the fact that there are varieties in the forms of those implements in different countries. Their principle is, indeed, the same; there is a great general resemblance both in the material of which they are made, and in the gracefulness of the form; but, with all these resemblances, there are still characteristic differences:

" 'Facies non omnibus una,
Nec diversa tamen, qualis decet esse sororum.'

" The swords of bronze that are found in these islands are characterized by the absence of a solid hilt of metal. Those of the Continent rarely want it. They are further characterized by a peculiar flatness of blade; those of the Continent are rimmed in a peculiar manner, which, with little observation, enables us to throw them into seven or eight separate classes, all indicative, as I believe, of different dates of antiquity. One peculiarity I am bound to mark, namely, the smallness of the hilt, leading us to the conviction that they must everywhere have been used by a race of diminutive proportions. Again, they are characterized by a total absence of guard, in which they appear to differ from the similar form, which we meet with in bas-reliefs on urns, and gems of Grecian origin. In these, according to the measurement made from many hundred specimens, the hilt is found to bear a very different proportion to the blade, and on the vast majority of Etruscan urns there is a well-defined guard, often of considerable size. Some, it is true, of the Etruscan swords of the earliest class want this; and this is a consideration which re-

quires to be carefully weighed. It has been very generally the habit of archæologists to attribute these bronze weapons entirely to the Celtic race; and, although there are great ethnological difficulties in the way of adopting this view, I am inclined to believe there is much to be said in its favour. The concurrent testimony of all ancient history proves to us, that at the time when the nations we call classical first came in contact with those of the North, both Celt and German had long been in the possession of iron, and formed all their implements of war of that metal. But this does not prevent the possibility of a still earlier race having introduced the sword of bronze of that graceful form with which we are all acquainted; and that these long continued in use, together with the iron weapons which were more particularly affected by the conquerors of Rome. The Roman sword itself, as we know from the undoubted testimony of Polybius, was only replaced by a short stabbing weapon, in the time of the second Punic War; and from the same authority, we know that its pattern was derived from the Iberians in Spain. If now, as is highly probable, those Iberians were only one portion of a vast race, spread over the whole Continent and the islands of Europe, who gradually yielded before the advancing wave of Celtic culture, and were driven into the extreme corners of the West and the North, there is no great improbability that the weapons which they had used, and introduced, continued to be found at a time when the other race was armed with a very different one; and, indeed, I am called upon here to remark, that written history is very sparing in its notice of nations armed with bronze; that nearly the only race of whom this is asserted are the Massagetæ, the progenitors of those Iberians of the Colches, whose connexion with the Iberians of Spain will now hardly be denied. They possessed neither iron nor silver, but had an abundance both of bronze and gold; and they formed their weapons of the former, and their ornaments of the latter metal. That the only other race of whom it is distinctly stated that

they used weapons of bronze, were the Iberians of Lusitania; and that the somewhat weak authority of Xiphilunis repeats the same tradition of a portion of the tribes of Britain. If, now, this short stabbing sword found its way from the East, along the upper coast of Africa, into Spain, and from Spain along the western shores both of France and England into this island, we may readily account, not only for its occurrence in such numerous cases, but also for its continuance at a period when iron weapons were generally used by the Celtic invaders, who occupied the more eastern portion of these islands. And it is a fact of great cogency, that hitherto no mould for the casting of these swords has been found in these islands. Moulds for the production of spears, of rapiers, and other implements of war, have, from time to time, been found; but as yet, for any thing we know, the leaf-shaped sword may have been the result solely of importation from another land. I do not know that there is anything particularly distinguishing the collection of swords in the Royal Irish Academy from those found in other parts of Britain, except the great numbers in which they are found. One form, indeed, I have observed which appears to me to be perfectly unique, and in which, while all the outline is carefully preserved, a bend is given to the blade, making it approach something of the form of a Turkish yataghan. This, as far as my experience goes, is entirely unique in Europe. Amongst those weapons of offence which belong to the class of swords, and which, to the best of my knowledge, have only been found in these islands, there occurs a long rapier-shaped blade of extremely finished workmanship, and, in fact, forming a most dangerous weapon of offence. It has been asked, whether these were not intended to be fixed on shafts, and used as substitutes for the more ordinary spear; but to this a decided answer can be given in the negative, for in the collection of your revered member, Dr. Petrie, is one admirably preserved specimen of this class, in which the handle, formed of hollow bronze, and fitted to the

blade with rivets, is a decisive and unmistakable characteristic. This sort of rapier, it appears, is only an extension of the dagger which has been frequently found both in England, Scotland, and Ireland, with a similar handle attached in a similar way.

"There is one class of weapons to which I am particularly anxious to call your attention, and of which you possess numerous well-arranged and interesting specimens. This is the weapon which is commonly called the 'celt,' or 'kelt,' but which, for purposes of distinction, it may be as well always to spell with a C, while we reserve the hard letter for the name of the nation. The origin of this word 'celt' is a Latin word, of what has been facetiously called 'middling and infamous Latinity,' namely, 'celtis,' a chisel; and there can be little doubt that this name is also very indicative of the uses to which it may occasionally have been turned. You are well aware that this is a novel point amongst archæologists; but it is one that, in my humble opinion, can give no difficulty. There can be no doubt that, according to the nature of the handle with which it is furnished, it may be a chisel, or a hoe, or a war-axe. Now, let me call your attention to the importance of consulting the habits of those tribes which are in a similar state to our forefathers at the period when those weapons were in use. Along the whole of the upper tracts of Siberia the Mongul tribes are in the habit of carrying a weapon formed in every respect like our celts, both in the shape which we call the socket, and that which, in imitation of our Danish friends, we have named palstave. The mode of fixing this with a handle is simple, but effective. A piece of bent wood, for which ash or blackthorn is admirably adapted, is fastened in the lower groove of the palstave; another piece of flat wood is placed within the upper groove; and the whole is then carefully wound round with the strong sinew of some animal; and thus is formed an implement which, from personal experience, I can assure you is capable of dealing a most deadly blow.

But a similar kind of the socket celt itself is found amongst the Galbo and Betuan tribes of Africa, differing in no conceivable point from the celt of our own forefathers, save in the material of which the implement is composed. In Africa, as in Siberia, it is of iron.

"There is, perhaps, nothing which so much attracts the attention of the stranger in visiting your noble collection, or on which, perhaps, you pride yourself more, than the unrivalled collection of gold ornaments which enrich this Museum; and you have, no doubt, reason to be proud of them, because they indicate an advanced stage of culture and a widely extended commercial intercourse between your forefathers and other nations of the world; but I would warn you to value them only on this account, for believe me, no more fatal danger can arise to Archæology, or, indeed, to the moral development of man, than fixing the eyes upon the intrinsic value of articles of ornament, rather than upon the art itself with which they are adorned. With the sole exception of the Museums of Scandinavia, which probably derived many of their treasures from successful thefts in this island, there is scarcely one European collection which shows anything like so great a wealth of personal ornament formed of precious metal. It is, indeed, possible that Gaul may have rivalry with you in its wealth of gold. Unhappily, the discoveries that have been made there have not been preserved with sufficient care, and avarice has consigned to the melting-pot specimens of ancient art, the study of which might have led us to conclusions of the utmost importance. There is nothing in those grand tiaras of gold which strike every stranger who enters the next room, that is unexampled in the Museums of Northern Germany, except as to the metal of which they are formed. The general outline is the same, and a good deal of the ornament is so also; but it is precisely at this point that I touch upon the archæological distinction, which, in my mind, is of the utmost possible importance, and to which I venture to call

the earliest attention of the Academy. The ornamentation is different in principle; and in this difference of principle, unless I greatly err, we should be led to detect some ethnographical and historical facts of very great importance to our study.

"The ornamentation which prevails upon almost all the bronzes of the Continent consist of a spiral line, which, to the best of my knowledge, is never found upon works of Irish art at this early period, but is invariably replaced by ornaments of concentrical circles. The spiral line to which I allude is, however, not a single one, but a double spiral, by means of which alone it is possible they could become continuous. A single spiral line drawn down from a point, and turning on itself, ends with a second circular figure, and goes no further. But if a second spiral spring from the centre, in a common point, in which the second follows the windings of the first, it escapes, and so renders it possible that a constant succession of this figure may be upon the same plain surface. Now, this figure is essentially and peculiarly Greek; it is found on the friezes of Greek temples; it is found in the monuments of Etruscan art, but it is not found upon the art of England and Ireland: and in this, I believe, lies the key to a historical distinction, which it is of great moment for us fully to comprehend and study. It bears upon a fact which has long become clear to me from a comparison of many other cognate facts—namely, the two great streams of culture that enrich the north of Europe: one, passing along from Upper Italy, over the Alps, into Slavonic lands; thence following the spurs of the Carpathians, spreading through Styria and Transylvania, through Moravia and Bohemia; next following the line of the Elbe, and flooding the countries between its banks and the southern coast of the Baltic—nay, even crossing the Baltic itself, to take in the south of Sweden and the Danish islands, ended, at last, in Holstein and Ditmarsh. While the second stream, coasting the north coast of Africa, ran westward and

northward, and found its principal development in this island of the Atlantic Ocean.

"But let me not be misunderstood. There is a peculiar development of the double spiral line, totally unknown to the Greeks, the Etruscans, and the nations of the Teutonic North, which is essentially characteristic, not only of the Scoto-Keltic, but the Britanno-Keltic populations of these islands. If the lines are allowed to diverge, instead of following one another closely in their windings, they produce that remarkable pattern which since a few years we have been in the habit of calling the trumpet pattern, and which, from one of its peculiarities, is sometimes called the *thumb* pattern. When this is represented in a plane surface, in the illuminations of MSS., you have that marvellously beautiful result which is familiar to you in the 'Book of Kells;' to us in the 'Book of St. Cuthbert,' or 'The Durham Book,' in the British Museum; and in the equally beautiful records of Scoto-Keltic self-devotion and culture in the MSS. of St. Gall in Switzerland. When, as is often the case in metal, this principle of the diverging spiral line is carried out in *repoussé*—when you have those singularly beautiful curves—more beautiful, perhaps, in the parts that are not seen than in those that meet the eye—whose beauty, revealed in shadow more than in form—you have a peculiar characteristic—a form of beauty which belongs to no nation but our own, and to no portion of our nation but the Keltic portion. There are traces of it, faint and poor, but sufficient for identification, among the Kelts of Normandy and the Keltic Helvetians. But the most perfect specimens of it are met with in these islands: I may mention, among them, that exquisite specimen of workmanship, the Goodrich Court shield, found in the bed of the river Witham, in Lincolnshire; the even prior specimens being parts of shields dredged out of the Thames in laying the foundations of Waterloo Bridge; the sword belonging to the Witham shield, now at Alnwick Castle; and one or two very beautiful spe-

cimens in this country, one of the very finest of which is in the collection of the College of St. Columba. You have several of them in the cases in the next room; and perhaps there is in all Europe no more striking one than an implement of unknown use in the possession of our great archæological master, Dr. Petrie. For beauty of design and beauty of execution this may challenge comparison with any specimen of cast bronze work that it has ever been my fortune to see. I have been able to notice but a few transcendant specimens; but works of this kind are far from rare. Although they began early —earlier than the intercourse of Rome with these islands— they continued late; and to the last moment of real, unmixed Keltic art, this is its great and distinguishing characteristic. It deals with curves, which are not arcs of a circle; the combinations which form its exquisite curved outlines are derived from the ellipse; its figures are not of the class we usually designate by the term geometrical. And, above all, it calls in the aid of enamel to perfect its work,—enamel, Gentlemen, not *cloisonné*, like the enamel of the East; no mosaic work of tesseræ, like so many so-called enamels of the Romans, but enamel, *champlevé*, as Philostratus described the barbarians, ἐν τῷ ὠκεάνῳ, the island-barbarians to have invented it. The Goodrich Court shield is ornamented with enamel—*champlevé* enamel, on its bronze baze. Many of your horse-trappings are so; more are so in England; and it is possible that the Britanno-Keltic art affected this mode of ornament more than the Scoto-Keltic. But let me remind you that this brilliant ornamentation of horse-furniture is distinctly noted by Pliny as a characteristic feature of Keltic art. The specimens that we have from Yorkshire, Suffolk, Norfolk, Somersetshire, Surrey, from Scotland, from this island, prove its wide dispersion, and justify the observations of the Roman admiral and philosopher. These are, in truth, the great characteristic differences to which I would, above all things, direct your attention. The engraved spiral line, with double winding, is

found from America to the Baltic, from Greece to Norway; but the divergent spiral line (*repoussé*, in metal of a later date), and ornamented with champlevé enamel, is found in these islands alone, or in the neighbourhood of these islands; it vanishes in proportion to its distance from them. There is in all this not the slightest trace of the influence of what we call classical art. The trumpet pattern is neither Greek, nor Roman, nor Oriental. There is nothing like it in Etruscan art; there is nothing like it in German or Slavonic art; there is little like it in Gallic or Helvetian art: it is indigenous, Gentlemen. The art of those Keltic tribes which forced their way into these islands of the Atlantic, and somewhat isolated here, developed a peculiar, but not the less admirable system of their own. And let me beg you to compare with it some of those admirable specimens of Germanic art of which England furnishes so many examples, in that country which was most continually subject to Frankish influence; and of which the finest examples of all are to be found in the cabinet of Mr. Mayer, of Liverpool. In these you have merely geometrical figures—circles and parts of circles, triangles and squares, lozenges and horizontal zig-zags. Enamel has ceased; it is replaced by niello. Amber is unknown; but turquoises and slabs of garnets, or coloured glass, have become common. Each form of art is beautiful in its way; but each has a character so peculiar that I will defy any observer to find any one point by which the two can be classed together, beyond the one that they both deal with metal, and are subservient to ornament.

"I am warned by time to close as rapidly as possible what I have to say; but I earnestly entreat you to take this point of ornamentation seriously into consideration, because it forms one of the most important and characteristic criterions by which to judge of the tendency of a race. Sir Wm. Hamilton has this evening well observed that there is some reason in every ornament why it recommended itself to some particular people. We do not know what the reason was, but the dif-

ference itself is of the deepest moment. Where the material of which implements are composed itself defines the form which will be imposed upon them, there can be but little variety, and the difference can never be characteristic; but where the material is of such a nature that free play is given to the artistic feelings of the workman—where, as in clay or bronze, he is at liberty to impose what form and lines he will upon the yielding material, then the spirit and feeling of art reveals itself in the form which he adopts, and the prevalence of this may be made the measure of his culture. There is nothing more characteristic than the pottery of those early races, because the material enabled the workman to give to it whatever shape his feelings induced him to devise; and I believe that though the careful study of ancient ceramic art will show that the graceful forms of the Greek potter had very likely at some early period found their way even to the coast of the Baltic, and remained there as models to be imitated—readily imitated, indeed,—but still the instructed eye recalled the tradition of a higher culture, and added one link more to the chain which binds the civilization of the North and of the South together.

"I am painfully conscious how imperfectly I have touched many of the important subjects on which I had to speak, and I would not have ventured to claim your attention for so long a period but for the strong feelings of respect I have for many labourers of your body, and for the wish that we may be found hereafter working as much as possible together in one well-considered spirit of united inquiry. No man values higher than myself that noble spirit which makes us look with love upon the records of our own ancestors, and of our own land; nor can any man feel prouder than myself in the conviction of the high state of culture to which the earliest denizens of this island had attained. It is this feeling which induces us to adopt a study which has but little attraction for the great mass of mankind, and must be pursued with little sympathy and no profit; which supports us during inquiries that must be made

in loneliness, and often in sinking of heart, and which, even when pursued successfully, obtains but little echo in the heart of the general public. But let us not forget that we are liable here to prejudice, against which it befits us manfully to strive—the confining too much the view of our own field, in a spirit of narrow inquiry, excluding the claims of others. It is precisely from this feeling that my learned friend, Dr. Worsaae, has been led to refer the culture of all the northern nations to the influence of his own Scandinavian forefathers; and it is in the same narrow spirit of inquiry that most of the French archæologists have laboured, to the great disadvantage of our common study.

"Now, Gentlemen, let us, with the full spirit of an enlightened patriotism, devote ourselves to the illustration of our own antiquities; let us love them, and, loving them, labour to bring them to light; but let us not believe that they are all we have to learn, or that they convey all that can be taught. Let us look upon them only as links in one great chain, which embraces many nations, and many periods of human culture, which has no place of its own, unless considered in co-ordination with other links in a still greater chain, but the full elaboration of which is necessary before its cosmic relation can be well and thoroughly comprehended. Let us be sure that we are not exclusive, but comprehensive, in what we do; and let us, above all things, never lose sight of this great truth, that the interests of man have at all times led to a close communion between the several divisions of his race,—that nothing can be dissociated in History, and that nothing must be dissociated in the study of Archæology. While labouring to perfect our own portion of the work, let us look out abroad, and encourage our fellow-labourers to perfect theirs; and let us make them feel as we feel ourselves, that the work can only be profitably done when all men are called to lay their hands to it.

"While complimenting you on the magnificent collection which the Academy has formed, let me not utter words which

may induce you to flag in the work, or deem that you have reached the utmost goal that you can gain. Let me remind you that this magnificent collection is held by you in trust for a great European and scientific end; that your wealth will be only the more full of use and beauty the more it is used to complete the collections of your less fortunate brethren. It is necessary, if those studies are to be anything more than laborious triflings, that we should all carefully understand that we are working towards one point, and in one spirit; that we should have a mutual reliance on each other—not believing that the products of our own land can exhaust the great subject of archæological study, but that each land has its own portion to bring into the common stock; and that, in proportion as each carefully elaborates its own collection, will be the beauty and solidity of the edifice which we can collectively raise."

MONDAY, FEBRUARY 23RD, 1857.

JAMES HENTHORN TODD, D.D., PRESIDENT, in the Chair.

REV. GEORGE SALMON read a Paper by Mr. A. Cayley, on Professor Mac Cullagh's theorem of the polar plane.

"A ray of polarized light, incident on the surface of an extraordinary medium, may give rise to a reflected ray and a single refracted ray; but this will be the case only for a particular position, or positions, of the plane of polarization of the incident ray. According to Professor Mac Cullagh's theory, the planes of polarization, and the relative vibrations of the three rays, are deduced from two assumed principles, which may be referred to as—

"1°. The principle of equivalent vibrations.

"2°. The principle of equivalent moments.

And from these principles are deduced,—

"3°. The principle of vis viva.

"4°. The theorem of the polar plane.

"The directions of the vibrations are completely determined by means of 4°, the theorem of the polar plane; and the relative magnitudes are then given by 1°, the principle of equivalent vibrations. The other principles, viz.:—2°, the principles of equivalent moments, and 3°, the principle of vis viva, must therefore follow as mere geometrical consequences from the first-mentioned two principles, or theorems; and I have found that the deduction depends immediately upon the following two theorems in spherical trigonometry.

"Suppose (Fig. 1, on next page) that $RR'R''$ is a spherical triangle, and let W be any point in the base RR'', and N be the central point of the base; then joining WR' and pro-

ducing this arc (in the direction from W to R') to a point L, such that

$$\cot WL = \frac{\sin^2 NW}{\sin WR \sin WR'} \tan WR',$$

and joining NR', then,

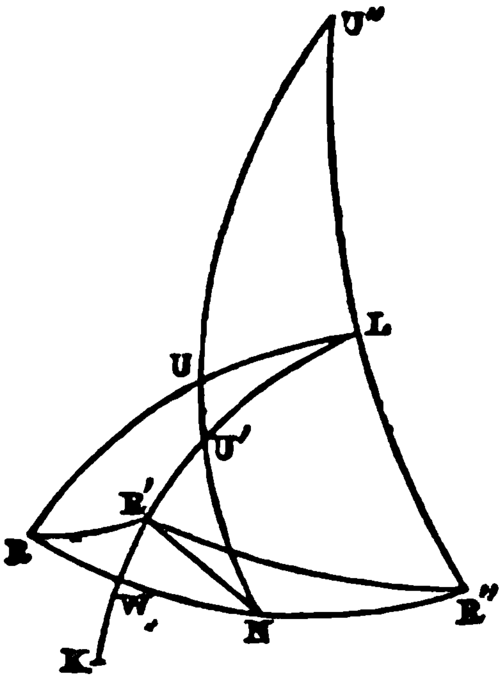

Fig. 1.

THEOREM I.

$$\frac{\sin^2 R''LR' - \sin^2 RLR'}{\sin^2 R''LR} = \frac{\sin NW \cos NR'}{\cos WR' \sin NR \cos NR'}.$$

And if we suppose also, that an arc through N, perpendicular to the base RR'', cuts LR, LR', and LR'' produced in the points U, U', U'', then,

THEOREM II.

$$\sin R''LR' \cos RU \sin NUR + \sin RLR' \cos R''U'' \sin NU''R''$$
$$= \sin R''LR \frac{\cos NW}{\cos WR' \sin NR} \cos R'U' \sin NU'R'.$$

" The present memoir contains the proof of the two theorems, and the application of them to the optical theory.

" To prove the first theorem, I write for shortness R, R'', W to denote the angles LRR'', $LR''R$, NWR', respectively; we have then,

$$\frac{\sin^2 R''LR' - \sin^2 RLR'}{\sin^2 R''LR} = \frac{\sin (R''LR' - RLR')}{\sin R''LR}$$

$$= \frac{1}{\sin R''LR} \{\sin R''LR' \cos RLR' - \sin RLR' \cos R''LR'\}$$

$$= \frac{1}{\sin R''LR} \left\{ \frac{\sin R''W \sin R''}{\sin LW} \cdot \frac{\cos RW - \cos LR \cos LW}{\sin LR \sin LW} \right.$$
$$\left. - \frac{\sin RW \sin R}{\sin LW} \cdot \frac{\cos R''W - \cos LR'' \cos LW}{\sin LR'' \sin LW} \right\}$$

$$=\frac{1}{\sin R''LR\sin^2 LW}\left\{\frac{\sin R''}{\sin LR}\sin R''W(\cos RW-\cos LR\cos LW)\right.$$

$$\left.-\frac{\sin R}{\sin LR''}\sin RW(\cos R''W-\cos LR''\cos LW)\right\}.$$

Or, observing that $\frac{\sin R''}{\sin LR}$, $\frac{\sin R}{\sin LR''}$, are each equal to $\frac{\sin R''LR}{\sin R''R}$, this becomes

$$=\frac{1}{\sin R''R\sin^2 LW}\{\sin R''W(\cos RW-\cos LR\cos LW)$$

$$-\sin RW(\cos R''W-\cos LR''\cos LW)\};$$

and, substituting for $\cos LR$, $\cos LR''$, the values

$$\cos RW\ \cos LW-\sin RW\ \sin LW\cos W,$$
$$\cos R''W\cos LW+\sin R''W\sin LW\cos W,$$

the foregoing expression becomes,

$$=\frac{1}{\sin R''R\sin^2 LW}$$

$$\times\{\sin R''W(\cos RW\sin^2 LW+\sin RW\sin LW\cos LW\cos W)$$
$$-\sin RW(\cos R''W\sin^2 LW-\sin R''W\sin LW\cos LW\cos W)\},$$

$$=\frac{1}{\sin R''R}\{\sin R''W\cos RW-\sin RW\cos R''W$$

$$+2\cot LW\sin RW\sin R''W\cos W\}$$

$$=\frac{1}{\sin R''R}$$

$$\times\{\sin(R''W-RW)+2\cot LW\sin RW\sin R''W\cos W)\};$$

and, putting $R''W-RW=2NW$, and substituting also for $\cot WL$ its value, which gives $\cot LW\sin RW\sin R''W=\sin^2 NW\tan WR'$, the expression becomes,

$$=\frac{1}{\sin R''R}\{\sin 2NW+2\sin^2 NW\tan WR'\cos W\};$$

but we have

$$\cos W = \frac{\cos NR' - \cos NW \cos WR'}{\sin NW \sin WR};$$

and therefore,

$$2\sin^2 NW \tan WR' \cos W = 2\frac{\sin NW}{\cos WR'}\cos NR' - \sin 2NW;$$

or the expression becomes,

$$= \frac{1}{\sin R''R}\, 2\,\frac{\sin NW}{\cos WR'}\cos NR'.$$

And $\sin R''R = \sin 2NR = 2\sin NR \cos NR$, so that finally the expression becomes

$$= \frac{\sin NW \cos NR'}{\cos WR' \sin NR \cos NR},$$

which proves the theorem.

"To prove the second theorem, take as before R, R'', W, to denote the angles LRR'', $LR''R$, NWR', respectively; and moreover, U, U', U'' to denote the angles NUR, $NU'R'$, $NU''R''$, respectively; then considering, first, the function on the left-hand side, viz.:

$$\sin R''LR' \cos RU \sin U + \sin RLR' \cos R''U'' \sin U'',$$

we have

$$\sin U = \frac{\sin NR}{\sin RU},$$

$$\cos RU \sin U = \sin NR \cot RU$$
$$= \sin NR \cos R \cot NR = \cos R \cos NR,$$

and in like manner,

$$\sin U'' = \frac{\sin NR''}{\sin R''U''},$$

$$\cos R''U'' \sin U'' = \sin NR'' \cot R''U''$$
$$= \sin NR'' \cos R'' \cot NR'' = \cos R'' \cos NR'' = \cos R'' \cos NR,$$

and the expression thus becomes

$$= \cos NR\ \{\sin R''LR' \cos R + \sin RLR' \cos R''\},$$

which is

$$= \cos NR \left\{ \frac{\sin R''W \sin W}{\sin R''L} \cdot \frac{\cos WL - \cos RW \cos RL}{\sin RW \sin RL} - \frac{\sin RW \sin W}{\sin RL} \cdot \frac{\cos WL - \cos R''W \cos R''L}{\sin R''W \sin R''L} \right\}$$

or, substituting for cos RL, cos $R''L$ the values—

$$\cos RW \cos WL - \sin RW \sin WL \cos W,$$
$$\cos R''W \cos WL + \sin R''W \sin WL \cos W,$$

the expression becomes

$$\frac{\cos NR \sin W}{\sin RL \sin R''L}$$
$$\times \left\{ \frac{\sin R''W}{\sin RW} (\cos WL \sin^2 RW + \sin WL \sin RW \cos RW \cos W) + \frac{\sin RW}{\sin R''W} (\cos WL \sin^2 R''W - \sin WL \sin R''W \cos R''W \cos W) \right\}$$
$$= \frac{\cos NR \sin W}{\sin RL \sin R''L}$$
$$\times \{ 2 \cos WL \sin RW \sin R''W + \sin WL \sin (R''W - RW) \cos W \}$$
$$= \frac{\cos NR \sin W \sin WL}{\sin RL \sin R''L}$$
$$\times \{ 2 \cot WL \sin RW \sin R''W + \sin (R''W - RW) \cos W \}.$$

Or, putting for cot WL its value, which gives

$$\cot WL \sin RW \sin R''W = \sin^2 NW \tan WR',$$

and putting also

$$\sin (R''W - RW) = \sin 2NW = 2 \sin NW \cos NW,$$

the expression becomes

$$= \frac{2 \cos NR \sin W \sin WL \sin^2 NW}{\sin RL \sin R''L} (\tan WR' + \cot NW \cos W).$$

The right-hand side of the equation to be proved is

$$\sin R''LR \frac{\sin NW}{\cos WR' \sin NR} \cos R'U' \sin U',$$

and we have

$$\sin R''LR = \frac{\sin RR'' \sin R}{\sin R''L}, \qquad \sin R = \frac{\sin WL \sin W}{\sin RL},$$

and consequently

$$\sin R''LR$$

$$= \frac{\sin RR'' \sin WL \sin W}{\sin RL \sin R''L} = \frac{2 \sin NR \cos NR \sin WL \sin W}{\sin RL \sin R''L},$$

or the expression is

$$= \frac{2 \cos NR \sin WL \sin W}{\sin RL \sin R''L} \cdot \frac{\sin NW}{\cos WR'} \cos R'U' \sin U'.$$

But we have

$$\sin U' = \frac{\sin NW}{\sin W'U'};$$

and therefore

$$\frac{\sin NW}{\cos WR'} \cos R'U' \sin U' = \sin^2 NW \frac{\cos R'U'}{\cos WR' \sin WU'}$$

$$= \sin^2 NW \frac{\cos(WU' - WR')}{\cos WR' \sin WU'}$$

$$= \sin^2 NW (\tan WR' + \cot WU').$$

But we have $\cot WU' = \cot NW \cos W$, and the expression becomes

$$= \frac{2 \cos NR \sin W \sin WL \sin^2 NW}{\sin RL \sin R''L} (\tan WR' + \cot NW \cos W);$$

which is the expression previously found as the value of the left-hand side of the equation, and the theorem is therefore proved.

"It is obvious that the point L might have been constructed by taking on $R'W$, produced in the direction from R' to W, a point K such that

$$\tan KW = \frac{\sin^2 NW}{\sin RW \sin R''W} \tan WR',$$

and then taking the arc KL in the reverse direction equal to $90°$.

"Passing now to the optical problem, it will be recollected

that in Mac Cullagh's theory the direction of vibration in an extraordinary medium is perpendicular to the plane of the ray and wave normal, and that the polar plane of a refracted ray is by definition a plane through the point of incidence parallel to the direction of vibration, and also parallel to a line joining the extremity of the ray with the corresponding point on the *Index surface*,—the last-mentioned surface being the polar reciprocal of the refracted wave-surface, taken with respect to the reflected wave-surface, or wave-sphere, contemporaneously generated. We have to consider a ray of polarized light incident on the surface of an extraordinary medium, and giving rise to a reflected ray and a single refracted ray. Let the incident ray and the reflected ray be respectively produced within the medium, and let the three rays, viz., the incident ray produced, the refracted ray, and the reflected ray produced, be represented in direction (see Fig. 2) by AR, AR' and AR''; and take $AR = AR'' = 1$ as the radius of the wave-sphere and AR' as the radius of the wave-surface, corresponding at a given instant of time to the first or ordinary medium and the extraordinary medium respectively. Take also AW as the perpendicular on the tangent plane of the wave-surface

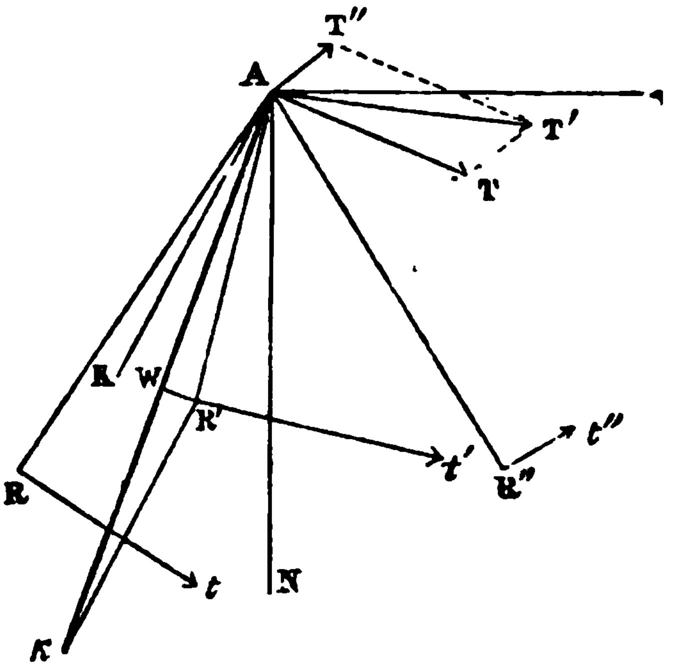

Fig. 2.

at R', or 'wave-normal,' corresponding to the refracted ray AR'; and let AN represent the normal to the plane of separation of the two media, and AH the intersection of the last-mentioned plane with the plane of incidence. The lines AR AR'', AW, AN, AH are of course all of them in the plane of incidence, the line AN bisects the angle made by the lines AR, AR'', and the lines AN, AH are at right angles to each other. The length of the wave-normal AW is given by the equation $AR \sin NAW = AW \sin NAR$, or putting, as above,

$AR = 1$, and representing the two angles at A by NW, NR respectively, then, if p denote the length of the wave-normal, we have $\sin NW = p \sin NR$. Take κ the pole of the tangent plane of the wave-surface at R' (or, what is the same thing, the image of the point W), in respect of the sphere radius AR, then κ will be the point on the index-surface corresponding to the point R' of the wave-surface; and let AK be drawn through the point A parallel to $R'\kappa$. Take AT' perpendicular to the plane WAR' (or, what is the same thing, the plane KAR') as the direction of the refracted vibration, the plane KAT' will be the polar plane; and by 4°, the theorem of the polar plane, the directions of the incident and reflected vibrations are given as the intersections of the polar plane with the wave-fronts or planes through A normal to the directions of the incident and reflected rays respectively; these intersections are represented in the figure by AT and AT''. The relative magnitudes of the vibrations are then determined by 2°, the principle of equivalent vibrations, viz., considering these vibrations as forces acting in the given directions AT', AT, AT'' respectively, the refracted vibration will be the resultant of the incident and reflected vibrations: the terminated lines AT', AT, AT'' in the figure are taken to represent in direction and magnitude the vibrations corresponding to the refracted ray and to the incident and reflected rays respectively, and the lines $R't'$, Rt, $R''t''$ are drawn through the extremities R', R, R'' of the three rays equal and parallel to AT', AT, and AT'' respectively. Let m', m, m'' denote the masses of ether set in motion by the three rays respectively, then, according to Mac Cullagh's hypothesis of equal densities, we have

$$m = m'' : m' :: AR \cos RN : \frac{AW \cos R'N}{\cos WR'},$$

(where RN, &c., denote the angles RAN, &c.); or writing as before, $AR = 1$, $AW = p$, where $\sin NW = p \sin RN$, we have

$$m = m'' : m' :: \cos RN : \frac{p \cos R'N}{\cos WR'} \left(= \frac{\sin NW \cos R'N}{\cos WR' \sin RN} \right).$$

This being premised, then, 3°, the principle of vis viva is that

$$m\,(Rt)^2 = m'(R't')^2 + m''(R''t'')^2;$$

or, what is the same thing,

$$\frac{Rt^2 - R''t''^2}{R't'^2} = \frac{m'}{m} = \frac{\sin NW \cos R'N}{\cos WR' \sin RN \cos RN}.$$

" And 2°, the principle of equivalent moments, is that the moment of $R't'$ round the axis AH, is equal to the sum of the moments of Rt and $R''t''$ round the same axis. It only remains to show that these two properties are in fact contained in the Theorems I. and II.

" The point κ is the image of W in a sphere-radius unity. Hence, $A\kappa = \frac{1}{p}\ \kappa W = \frac{1}{p} - p$, and, therefore,

$$\tan W\kappa R' = \frac{p \tan WR'}{\frac{1}{p} - p} = \frac{p^2 \tan WR'}{1 - p^2} = \tan KW,$$

but we have, as before, $\sin NW = p \sin RN$, and consequently,

$$\tan KW = \frac{\sin^2 NW \tan WR'}{\sin^2 RN - \sin^2 RW}$$

$$= \frac{\sin^2 NW}{\sin RW \sin R''W} \tan WR'.$$

" Suppose now that the points R, R', R'', W, N, H, K, of Fig. 2, are all of them projected by radii through the centre A upon a sphere, radius unity (see Fig. 3, where the several points are represented by the same letters as in Fig. 2); and complete Fig. 3 by connecting the different points in question by arcs of great circles, and by producing KW (in the direction from K to W) to a point L, such that $KL = 90°$, and by joining LR, LR'', and drawing the arc $NU'UU''$ at right angles to $R''R$ (or, what is the same thing, with the pole

H) meeting LR', LR, and LR'' produced, in the points U', U, U'' respectively. By what has preceded, the points K, L of Fig. 3 are constructed precisely in the same manner as the same points in Fig. 1, and in fact Fig. 3 is nothing else than Fig. 1 with some additional lines and points. The condition employed to determine the magnitude of the vibrations Rt, $R't'$, $R''t''$, gives that these vibrations are as

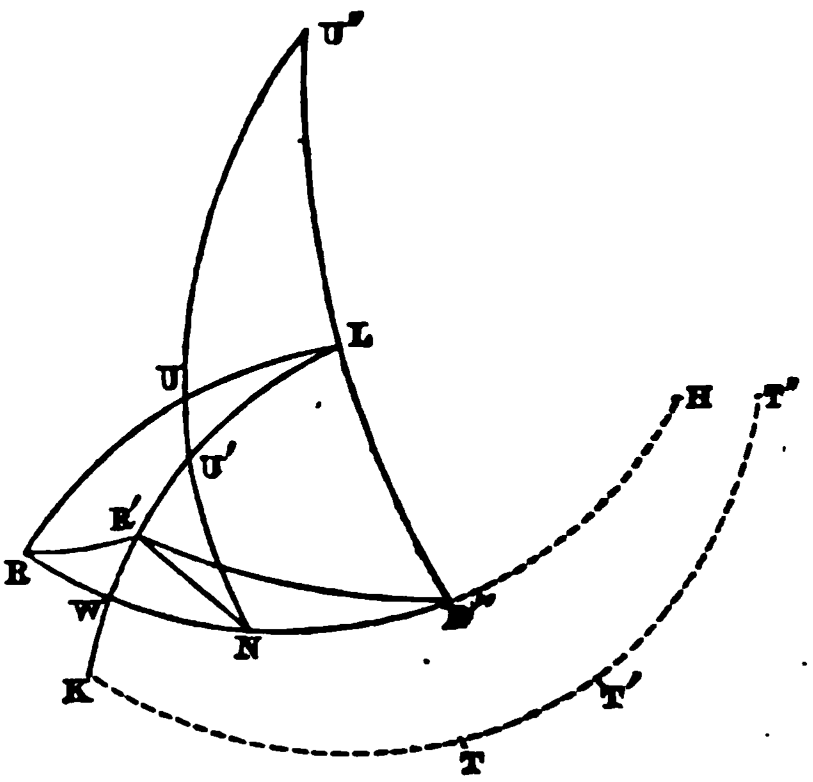

Fig. 3.

$$\sin T'T'' : \sin TT'' : TT',$$

or, observing that LR, LR', LR'' are the great circles whose poles are T, T', T'' respectively, these vibrations are as

$$\sin R''LR' : \sin RLR'' : \sin RLR';$$

and, substituting these values, the equation given by the principle of vis viva becomes identical with that of Theorem I.

"Proceeding to the condition given by the principle of equivalent moments, we have

$$\text{moment of } Rt \text{ round } AH$$

$$= Rt \times AR \times \cos [AR, \perp \text{dist} (Rt, AH)] \times \sin (Rt, AH);$$

and in Fig. 3, observing that the radius through U is parallel to the perpendicular distance of (Rt, AH) (for LR has the pole T, and NU the pole H) then

$$\cos [AR, \perp \text{dist} (Rt, AH)] = \cos RU,$$
$$\sin (Rt, AH) = \sin TH,$$

or, since T and H are the poles of LR and NW respectively, $TH = \angle NUR$, and, putting $AR = 1$, the moment is

$$= Rt \cos RU \sin NUR.$$

Similarly,

$$\text{moment of } R''t'' \text{ round } AH$$
$$= R''t'' \cos R''U'' \sin NU''R''.$$

And for the refracted ray,

$$\text{moment of } R't' \text{ round } AH$$
$$= AR' \times R't' \cos R'U' \sin NU'R'.$$

But we have

$$AR' = \frac{AW}{\cos WR'} = \frac{\sin NW}{\cos WR' \sin NR'},$$

ınd, therefore, the moment is

$$= R't' \frac{\sin NW}{\cos WR' \sin NR} \cos R'U' \sin NU'R'.$$

And the vibrations Rt, $R''t''$, $R't'$, as before, are as

$$\sin R''LR' : \sin RLR' : \sin RLR'',$$

whence the equation given by the principle of equivalent moıents is precisely that of Theorem II."

Mr. M. Donovan exhibited and described a moveable hozontal sun-dial, invented by himself, which shows apparent ılar time within a small fraction of a minute.

MONDAY, MARCH 16TH, 1857. (Stated Meeting.)

JAMES HENTHORN TODD, D.D., PRESIDENT, in the Chair.

THE Secretary of the Council read the following Report from the Council:—

REPORT.

In presenting their Report for the past year, the Council have, in the first place, to call the attention of the Academy to the progress which has been made in publishing their Transactions since the 16th of March last.

The First Part of the Twenty-Third Volume has been published, containing Mr. Donovan's paper on "Galvanometric Deflexion," Mr. Haughton's paper on "The Solar and Lunar Diurnal Tides on the Irish Coast," and Mr. Mallet's paper on "The Physical Conditions involved in the Construction of Artillery."

It will be remembered that the observations upon which Mr. Haughton's highly valuable paper is based were undertaken by the Academy in the year 1850. The Council have to congratulate the Academy on the valuable result which Mr. Haughton's zeal and ability have deduced from the task which they undertook,—a result which they hope will soon be completed by the discussion of the question of Semi-Diurnal Tides.

Another Science Part of the Twenty-Third Volume of the Transactions is in progress.

Mr. Salmon's paper on "Reciprocal Surfaces" has been printed off. Mr. Renny's paper on "The Hygrometric Correction of Barometrical Measurement," and Professor Downing's paper on "The Draining of the Haarlem Lake," are both in type; and Mr. Forster's paper on "The Molecular Formation of Crystals" is in the compositor's hands.

Towards a Polite Literature Part of the same Volume, the following progress has been made:—

Dr. Hincks' paper on "The Personal Pronouns of the Assyrian Language," and on "A Tablet in the British Museum," have been printed off; as also the Rev. Dr. Wills' paper on "Dreams."

In Antiquities, a paper by the President on "An Ancient Irish Missal" has been printed off.

In the publication of the last Numbers of the Proceedings there has been an unavoidable delay, in consequence of the difficulty in obtaining an exact report of Mr. Kemble's valuable communication. This, however, is merely an accidental obstruction, and will soon be removed. The Proceedings have, with this exception, appeared regularly.

Before leaving this part of the subject, the Council are happy to inform the Academy that they have concluded an arrangement with the Royal Society of London, in virtue of which that body will undertake the circulation in England and on the Continent of the Scientific Part of our Proceedings;—the expense of printing the additional numbers required to be borne by the Academy; and the expense of postage by the Royal Society. The additional publicity thus given to our labours cannot fail to have a beneficial effect.

During the past year we have had the following contributions to our Transactions and Proceedings:—

In Pure Mathematics we have had papers from Sir William R. Hamilton, Professor Boole, and Mr. Campbell.

In Mixed and Applied Mathematics, from Sir William R. Hamilton, Mr. Cayley, Professor Jellett, Professor Haughton, Professor Hennessy, Mr. Sanders, and Mr. Donovan.

In the Sciences of Observation and Experiment, from Dr. Robinson, Professor Haughton, and Dr. Barker.

In Polite Literature we have had a communication from Mr. Clibborn.

In Antiquities, from the President, Dr. Wilde, Dr. Petrie, Dr. Reeves, Mr. Haliday, Mr. Kemble, and Mr. Hitchcock.

The formation of a Catalogue of our Museum has long been a subject of anxiety to the Council, and it has been with great regret that they have hitherto found themselves unable to announce to the Academy that any sensible progress had been made in that work. On the present occasion, however, they are happy to have it in their

power to state that a very liberal proposal has been made to them by Mr. Wilde, stating his willingness to undertake the task of arranging and cataloguing the articles in the Museum, and laying before the Council an account of the plan upon which he proposes to perform this work. This proposal, which has been approved of by the Council, is to be found in their Minutes; and an estimate of the probable cost will be laid before you to-night. Should you approve of it, we have every reason to hope that this important work will be executed without further delay. Some difficulty has arisen from the request formerly made by the Board of Works,—that their contributions might be kept separate from others; but we have reason to hope that this request, which would render impossible a scientific arrangement of our Museum, will not be insisted on.

Meanwhile, it will be interesting to the Academy to learn that the work has already made some progress.

The stone articles have been arranged and classified. 106 engravings have been drawn on wood; twenty-five are already cut and in the printers' hands; and the first sheet of the Catalogue is in type.

The Council have entered upon the task of arranging and classifying the By-Laws, with a view to their being rendered more generally intelligible to the Members of the Academy. They have no doubt that this subject will be taken up by the new Council, and that the result of their labours will be shortly laid before you.

An important modification has been made in the law for promoting rotation on the Council. By this change the Vice-Presidents have been subjected to the rule which declares it expedient that the senior Member of each Committee should be removed; and it has been provided that this rule shall not take effect in any Committee in which a natural vacancy occurs.

Large additions have been made to the Library during the past year both by donation and purchase,—chiefly in the department of Irish History and Literature. The number of donations has been unusually large, including, as the Academy will remember, a valuable gift from the widow of the late R. Hitchcock, Esq.

The work of placing and cataloguing the printed books in the Library is now so far finished, that the south wall book-cases of the Gallery alone remain to be done. The Council therefore hope to

be able to realize shortly the suggestions thrown out by the President in his Inaugural Address, and adopt such plans for the future management of the Library as will make it ancillary to the threefold objects of the Academy.

During the past year we have lost seven Members by death. Their names are:—

HALIDAY BRUCE, Esq.; elected November 12, 1838: died December 4, 1856.

RIGHT REV. JAMES WILSON, D. D., Lord Bishop of Cork, Cloyne, and Ross; elected Oct. 28, 1822: died January, 1857.

JOHN FINLAY, LL. D.; elected December 11, 1837: died May 11, 1856.

REV. THOMAS D. HINCKS, LL. D.; elected March 16, 1803: died February, 1857.

JAMES PIM, Esq.; elected November 30, 1833: died November 13, 1856.

ISAAC WELD, Esq.; elected March 15, 1800: died August 4, 1856.

WILLIAM HENN, Esq.; elected May 12, 1845: died March 9, 1857.

Thirteen Members have been elected into the Academy since the last Annual Meeting. Their names are:—

Charles Copland, Esq.
Nicholas Smith O'Gorman, Esq., A. M.
G. Johnstone Stoney, Esq., A. M.
Thomas H. Ledwich, Esq.
John H. Otway, Esq.
Dominick M'Causland, Esq.
Robert M'Dermott, Esq., M. B.
Rev. James M'Ivor, A. M.
Sir Colman M. O'Loghlen, Bart.
Robert Patterson, Esq.
John R. Kinahan, Esq., M. B.
Frederick Field, Esq.
Robert M'Donnell, Esq.

The following payments have been made by the Committee of Antiquities from 1st of April, 1856, to 16th of March, 1857, on account of the purchase of Antiquities for the Royal Irish Academy's Museum:—

F. A. Rourke, coins, ...	£0 10 0
W. F. Wakeman, balance of account, ...	3 0 0
D. Egan, antique dagger, ...	0 10 0
T. Kelly, an iron vessel, ...	0 10 0
R. Glennon, a collection of bronze, iron, and bone articles, ...	15 0 0
J. Carey, gold head-dress, ...	25 0 0
J. Johnson, repairs of same, ...	0 10 0
James O'Donnell, brass vessel, ...	1 0 0
	£46 0 0

The Ballot for the annual election of President, Council, and Officers, having been scrutinized in the face of the Academy, the President reported that the following gentlemen had been duly elected President, Council, and Officers for the ensuing year:—

President.—James Henthorn Todd, D. D.

Committee of Science.

Robert Ball, LL. D.; Sir Robert Kane, M. D.; Rev. Humphrey Lloyd, D. D.; Rev. George Salmon, A. M.; Sir William R. Hamilton, LL. D.; William H. Harvey, M. D.; Rev. Samuel Haughton.

Committee of Polite Literature.

Rev. William H. Drummond, D. D.; Rev. Charles Graves, D. D.; Rev. John H. Jellett, A. M.; Rev. G. Sidney Smith, D. D.; John Kells Ingram, LL. D.; John O'Donovan, LL. D.; Rev. Samuel Butcher, D. D.

Committee of Antiquities.

George Petrie, LL. D.; William R. Wilde, Esq.; Joseph Huband Smith, Esq.; Denis Henry Kelly, Esq.; Charles Haliday, Esq.; John T. Gilbert, Esq.; Rev. William Reeves, D. D.

Treasurer.—Robert Ball, LL. D.

Secretary to the Academy.—Rev. Charles Graves, D. D.

Secretary to the Council.—Rev. J. H. Jellett, A. M.

Secretary of Foreign Correspondence.—W. R. Wilde, Esq.

Librarian.—Rev. William H. Drummond, D. D.

Clerk, Assistant Librarian, and Curator of the Museum.—Mr. Edward Clibborn.

The President nominated, under his hand and seal, the following Vice-Presidents:—

Sir Robert Kane, M. D.; Rev. George Sidney Smith, D. D.; Rev. Humphrey Lloyd, D. D.; Rev. William Reeves, D. D.

Moved by the Rev. J. H. Jellett, and seconded by W. R. Wilde, Esq., and—

Resolved,—That the Council be authorized to expend a sum not exceeding £250, in the arranging and cataloguing of the Academy's Museum.

Moved by Frederick J. Sidney, Esq., and seconded by the Rev. John H. Jellett, and—

Resolved,—That a list of all additions to the Library during each year be printed and distributed to the Members along with the Annual Report—distinguishing purchases from donations—and specifying the proportion of the Annual Grant devoted to the several departments of Science, Polite Literature, and Antiquities.

Resolved,—That the Report, with this list as an Appendix, be adopted.

MONDAY, APRIL 13TH, 1857.

JAMES HENTHORN TODD, D. D., PRESIDENT, in the Chair.

JAMES CLELAND, Esq., Captain Leach, R. E., Denis Florence Mac Carthy, William Moore, Esq., M. B., and James H. Sawyer, M. D., were elected Members of the Academy.

The President announced the decease of Robert Ball, LL.D., late Treasurer to the Academy, and read a notice of his services to the Academy, and the other institutions with which he had been connected, and his loss to science generally.

IT WAS RESOLVED,—That the Academy, on the declaration of the result of the Ballot for Members, do adjourn, in testimony of their regret for the loss of Dr. Ball, and of respect for his memory.

Monday, April 27th, 1857.

JAMES HENTHORN TODD, D.D., President, in the Chair.

On the recommendation of the Council the following Resolutions were adopted by the Academy.

1. That the several Committees of the Council shall hold seven stated meetings annually, one in each of the months of January, February, March, April, May, June, and November; and that attendance on such meetings shall reckon as attendance at the meetings of the Council; and that the number of attendances requisite to qualify a member of Council for re-election be increased from seven to ten. The attendances of a Member not to be reckoned on two Committees.

The Committees intended by the foregoing recommendation are, Science, Polite Literature, Antiquities, Economy, and Library.

2. To require from the Treasurer, on his appointment, solvent security to the amount of £2000 sterling, in the form of a bond, for the faithful discharge of his office.

Mr. M. Donovan read a paper on a new and singular Acoustic Phenomenon.

Professor Stoney exhibited and described a new arrangement of "Grove's Battery."

The Rev. Samuel Haughton stated that, at the request of the Council of the Academy, he was about to lay before them a short statement of the circumstances connected with the expedition to the neighbourhood of the Magnetic Pole, about to leave England, under the command of their countryman,

Captain F. L. M'Clintock, R. N. This gallant officer had offered his services to Lady Jane Franklin, in a manner which was as disinterested as it was chivalrous. Every person who had the honour of this officer's acquaintance would bear testimony to the high value of the services he had already rendered to his country and to science, during the three Arctic expeditions in search of Sir John Franklin, in which he had already assisted: first, under the command of Sir James Ross, in 1848–9; secondly, under the orders of Captain Austin, in 1850–51; and thirdly, in command of the screw steamer, Intrepid, in company with the Resolute, commanded by Captain Kellett, in 1852–3. A short account of these expeditions had been recently laid by Captain M'Clintock before the Royal Dublin Society, in whose Museum were deposited the valuable zoological and geological specimens collected by him during the period of the expeditions.

As was now well known, all these and other searching expeditions had taken too northerly a direction, and the locality of Sir John Franklin's ships was now ascertained to lie within narrow limits, easily reached in a single year. Notwithstanding repeated applications in Parliament and elsewhere, the Admiralty had decided on not prosecuting any further search for the Erebus and Terror; and, under these circumstances, it remained for Lady Franklin to decide what steps she would herself take in the matter. She did not hesitate a moment; and decided on sending out her own expedition, although probably at a cost ruinous to an individual. She purchased the late Sir Richard Sutton's screw schooner yacht, built with diagonal planking, and thankfully availed herself of Captain M'Clintock's generous offer to take the command of her expedition. The manner in which the offer was made by him, and accepted by her, is highly creditable to both, and is a circumstance of which M'Clintock's countrymen may well feel proud.

Mr. Haughton then read the following letter received by him on Friday last from Captain M'Clintock:—

"The Admiralty have just granted me leave of absence for the purpose of conducting Lady Franklin's expedition. I regret not being able to hear your paper on Monday evening, but offer my sincere thanks for the helping hand you are giving us. I am now in a position which requires that I should offer my personal thanks to you. Within the last four days an address to the Admiralty has arrived from several influential New York people, requesting that the Resolute might be placed at the disposal of Lady Franklin."

It was generally understood that Lord Palmerston was personally favourable to the granting of Government aid to Lady Franklin's expedition, and the request of the New York merchants afforded the ground for making a definite request, viz., that the Resolute should be fitted out and provisioned at once, so as to sail with Lady Franklin's schooner.

Mr. Haughton then proceeded to state in detail the reasons why the Royal Irish Academy should address the Government on this important question, and explained the advantages to geographical and geological science which had already been the result of the preceding searching expeditions. In giving these reasons, Mr. Haughton said that he purposely abstained from mentioning other than purely scientific grounds, as he thought that the Royal Irish Academy, in this matter, was bound to consider only the results to science likely to result from Lady Franklin's search, if successful; and the risk of human life involved in the proposed search. Professor Haughton's statement, was illustrated by reference to a map of the Arctic Regions, and to Captain M'Clintock's paper on the three expeditions on which he had already served. The following is a brief summary of the points dwelt on by Professor Haughton:—

1st. It was highly probable, in the opinion of those competent to judge, that the Erebus and Terror were still in ex-

istence ; and, if so, it was nearly certain that near them would be found buried copies of Sir John Franklin and Captain Crozier's Journals, and of the scientific observations made before the crews perished, which would prove of the highest scientific value.

2nd. The locality in which the Erebus and Terror lie is easily reached, is circumscribed within narrow limits, and is in the neighbourhood of the North Magnetic Pole, which is looked upon with such interest by scientific observers. The extent of coast-line already traversed by the Government searching expeditions is 6500 miles. There remain to be discovered only 370 miles. The total number of miles traversed by sledges in the former expeditions was 44,000 miles. An expedition consisting of 100 persons might be expected to traverse from 7000 to 10,000 miles, with sledges, in a single year.

3rd. The rate of mortality for all the Arctic expeditions since 1818 (exclusive of the missing expedition) is *under* 1½ per cent. per annum, for which, and other reasons, Arctic service is extremely popular both with officers and men.

4th. It is not necessary for the complete exploration of the area described (see chart) to penetrate so far as to risk the detention of the vessels by the ice. In the event of involuntary detention, or accident to the ships, the crews can easily escape over the ice, with sledges and boats, either to the whalers, or to one of the three great depôts of provisions stored up at Port Leopold, Beechey Island, and Melville Island. In this manner the crews of Sir Edward Belcher's ships were withdrawn from their vessels, not of necessity, but in compliance with *Admiralty orders;* their crews being in good health, and another year's provisions remaining.

5th. Such danger to the ships of being crushed as exists, is annually encountered by the whalers ; and out of thirty vessels employed in the late searches, only one (Breadalbane) was

lost by ice-crushing. She was only a merchant ship employed to carry provisions; she had not been strengthened like the searching vessels, and had been kept in a most exposed and perilous position for fourteen days previous to the accident. This occurred near Beechey Island, where, had she been docked in the ice, in conformity with the usual practice, she would have been saved.

6th. The scientific results of the previous searching expeditions have not been made public by the Admiralty. Tide observations, magnetical and meteorological observations of the highest interest and value, were made during those expeditions; and it is manifestly unfair to decry the scientific results of those expeditions, when no opportunity of judging of them has been afforded to the scientific public, who alone are competent to judge of their value.

7th. The commercial value of previous Arctic explorations may be judged of by the following facts:—

1. Sir H. Gilbert's discovery of the Cod Fishery of Newfoundland.
2. Davis—Great Whale Fishery of West Greenland.
3. Hudson—Hudson's Bay and the Great Fur Company.
4. Sir John Ross—Whale Fishery of the north and north-west of Baffin's Bay.
5. Parry—Whale Fishery of Lancaster Sound, Barrow Strait, and Prince Regent's Inlet.
6. Beechey—Whale Fishery of Bhering's Straits. In this Fishery, in the space of two years the American whalers obtained cargoes amounting to eight million dollars in value.

8th. Lady Franklin's expedition affords the last hope of the discovery of a practicable north-west passage. Collinson's voyage has proved that the northern coast of the American continent can be safely navigated for an extent of 1400 miles east and west; and if there be a north-west passage at all, it must exist in the area proposed to be searched for the Erebus

and Terror. It has been already proved by the set of the tides that there is a water communication in this area.

It is proposed by Captain M'Clintock to make his way down Prince Regent's Inlet, and thence through Bellot's Strait, into the field of search; or to attack it directly, if the ice permits, by going down Peel Sound, which he has good reasons for believing to be a strait. If prevented by the ice from passing through Bellot's Strait, or going down Peel Strait, he will abandon the idea of taking the ship through the supposed north-west passage, and, leaving her in safety in Prince Regent's Inlet, will proceed to make the requisite search for the Erebus and Terror by sledging parties, so successfully used in the late expeditions, and in conducting which Captain M'Clintock particularly distinguished himself.

Professor Haughton concluded his statement by proposing the following Resolution:—

"That an Address be forwarded by the President, in the name of the Royal Irish Academy, to Lord Palmerston, praying him to give the consent of her Majesty's Government to the use of the Resolute by Lady Franklin's expedition, and of such Government stores as may be requisite for the full and efficient equipment of that expedition."

This Resolution was seconded by the Right Hon. Joseph Napier, M.P. for the University of Dublin, and carried unanimously by a crowded meeting, which appeared to take the liveliest interest in the success of the expedition.

Sir. W. R. Hamilton, LL. D., moved, and W. R. Wilde, Esq., seconded, the following Resolution, which was also adopted:—

"That the Seal of the Academy be affixed to the Address."

A ballot having taken place to supply the two vacancies in the Council, caused by the death of the late Treasurer, Robert

Ball, LL. D., and by the resignation of the Rev. J. H. Jellett, on the Committee of Polite Literature, the President declared that the Rev. J. H. Jellett had been placed on the Committee of Science, and that the Rev. Joseph Carson, D. D., had been named on the Committee of Polite Literature.

Dr. Apjohn having inquired of the President if he knew of any objection to the Academy proceeding at once to the election of Treasurer, and Secretary of the Council, and having been informed by the President that he was not aware of any By-Law of the Academy to prevent such election,—he moved, and John Francis Waller, LL. D., seconded, the following Resolution:—

"That the Academy do elect the Rev. Dr. Carson, Treasurer; and the Rev J. H. Jellett, Secretary of the Council."

As an amendment it was moved by Sir W. R. Hamilton, LL. D., and seconded by George Petrie, LL. D.:—

"That the Academy do adjourn the election of a Treasurer until the next night of meeting."

A division having been called for, it appeared that, exclusive of the tellers, twenty-one voted for, and twenty-eight against, the amendment.

The original Resolution having been proposed by the President, it was moved by John E. Pigot, Esq., and seconded by R. R. Madden, M. D.:—

"That the Academy do now adjourn."

The amendment having been negatived, the President put the original resolution, which was adopted.

A ballot having been called for, the President declared that the Rev. J. H. Jellett had been re-elected Secretary to the Council, and that the Rev. Joseph Carson, D. D., had been elected Treasurer to the Academy.

The Academy then adjourned.

MONDAY, MAY 11TH, 1857.

JAMES HENTHORN TODD, D. D., PRESIDENT, in the Chair.

JAMES ANTHONY LAWSON, Q.C., was elected a Member of the Academy.

Professor Hennessy read a paper on the Distribution of Heat over the island of Great Britain.

The President read the following note:—

"Sir William Rowan Hamilton wished to hand in a memorandum of the following 'General Expression by Quaternions, for Cones of the Third Order,' which he hoped to be allowed to develope and illustrate at some subsequent meeting of the Academy during the present Session. The equation in question is,

$$Sq\rho q'\rho q''\rho = 0; \qquad \text{(A)}$$

where ρ is the variable vector (or side) of the cone of the third order, drawn from its vertex as the origin; while q, q', q'', are three arbitrary but constant quaternions, which may be regarded as fixed parameters of the surface."

The following Memorial to Lord Palmerston was read:—

"*To the Right Honourable Lord Palmerston, &c., &c.*

"MAY IT PLEASE YOUR LORDSHIP,

"We, the President and Members of the Royal Irish Academy, beg leave to address you on a subject of great scientific interest and importance.

"We have learned with much regret that the Lords of the Admiralty have decided upon abandoning all further

search in the Arctic regions for the missing ships, Erebus and Terror, and that, in consequence, Lady Franklin has purchased a screw schooner yacht, which she is about to send out at her own private expense.

"We trust that your Lordship will not consider it unbecoming in a body like the Royal Irish Academy, one of whose main objects is the promotion of scientific inquiry, if we venture to solicit your Lordship's influence with the Lords of the Admiralty to induce them to reconsider their decision.

"We have heard that a petition from several influential merchants of New York has recently been presented to their Lordships, praying that the Resolute should be fitted out at the expense of the Government, for further Arctic exploration in search of the remains of the lost expedition.

"We beg leave to express our earnest hope that the principle of this request may be complied with; and, without dwelling on the philanthropic objects that may be attained by such an expedition, we beg to submit to your Lordship's consideration the following particulars, in which we conceive the interests of science are deeply concerned:—

"1. There can be little doubt that the Erebus and Terror must be in existence; and it is more than probable, from the known practice of officers engaged in Arctic research, that if even the wrecks of these vessels could be discovered, there would be found near them buried copies of the scientific observations made by Sir John Franklin and Captain Crozier, in the early part of their expedition; and it is needless to say that such observations would now be of the highest scientific value.

"2. The region within which the missing ships must lie is circumscribed within narrow limits, and is a region of the greatest scientific interest, from its proximity to the North Magnetic Pole. The extent of coast line already traversed by Government searching expeditions is 6500 miles, leaving to be discovered 370 miles only.

"3. It may be said that the scientific results of the former expeditions have been of little value; but of this it is impossible to judge until the Tidal, Magnetical, and Meteorological observations made during these expeditions have been published by the Admiralty. The scientific world have had, as yet, no opportunity of studying those observations, and, consequently, their value has been very unfairly assumed to be but small.

"4. Of the commercial importance of previous Arctic expeditions there can, however, be no second opinion. The cod fishery of Newfoundland was discovered by Sir H. Gilbert; the great whale fishery of West Greenland by Davis; and that of the north and north-west of Baffin's Bay by Sir John Ross; that of Lancaster Sound, Barrow Strait, and Prince Regent Inlet, by Parry; and that of Behring's Straits by Beechey; while to Hudson is due the discovery of the fur trade, since carried on with such profit by the Great Fur Company.

"5. The set of the tides has proved that there is a water communication between the Atlantic and Pacific Oceans, in the region proposed to be searched by Lady Franklin's expedition. Collinson's voyage has established the fact that the N. and N. W. coast of the American continent can be safely navigated for about 1400 miles east and west. If, therefore, there be a north-west passage, it must, in all probability, exist in the region where the Erebus and Terror may be expected to be found, and Lady Franklin's expedition, we may reasonably hope, if it be properly supported, will lead to the final settlement of the question.

"6. Further attempts at Arctic researches are often deprecated on the ground of their danger to the lives of the officers and men engaged in them. But we would represent to your Lordship that this is a mistake. The rate of mortality in all the Arctic expeditions (exclusive of the missing one under Sir John Franklin) is under 1½ per cent. per

annum; and this low rate, with other reasons, has rendered Arctic service extremely popular both with officers and men.

"7. It will not be necessary, for the complete exploration of the area in question, to penetrate so far north as to encounter the greatest danger incident to Arctic navigation, namely, the detention of the ships by ice. And in the event of such detention, or any serious accident, such as crushing of the vessels by the ice, the crews can easily escape with sledges and boats, either to the whalers, or to one of the three great depôts of provisions at Port Leopold, Beechey Island, and Melville Island, as was done by the crews under the command of Sir Edward Belcher, when, in obedience to his instructions, he was obliged to abandon his ships. 'There is *now* no known position, however remote' (we quote the words of Captain M'Clintock, in a communication recently made by him to the Royal Dublin Society), 'from which a well-equipped crew could not effect their escape by their own unaided efforts. We felt this; and by our experience, gained in a cause more glorious than ever men embarked in, have secured to all future Arctic explorers a plan by which they may rejoin their fellow-men.'

"In conclusion, we would earnestly entreat your Lordship not to permit this opportunity to be lost. Many circumstances, to some of which we have adverted, combine to create reasonable grounds of hope that the expedition now projected by Lady Franklin, if it should receive the assistance of her Majesty's Government, will be productive of important results. It is now well ascertained that all former expeditions sent out in search of Sir John Franklin had taken a direction too northerly, and that a single year may now suffice to explore the region in which the missing ships must lie. Captain M'Clintock, to whom Lady Franklin, with permission of the Admiralty, has intrusted the command of her schooner, proposes to make his way down Prince Regent's Inlet, and thence, through Bellot's Strait, to pass at once into the field

of search, and, if necessary, to conduct the search by sledging parties, in the use of which that officer has already had experience during the three Arctic expeditions in which he has so highly distinguished himself.

"We trust, therefore, were it only for the honour of England, that the ship so nobly restored to her Majesty by the people of the United States—a ship admirably adapted for the service—will be now sent out to aid the noble attempt of Lady Franklin to recover some tidings of the melancholy fate of her lamented husband and his companions, that she may have the gratification of receiving from the Government of her own country that sympathy which the citizens of New York, the Government of the United States, and, we may be permitted to add, the educated public of England and of this country, have already manifested in her behalf.

"Given in the name and under the corporate seal of the Royal Irish Academy, this 2nd day of May, 1857.

(Signed) "James H. Todd, D. D.,
"*President.*"

It was moved by the Rev. Samuel Haughton, and seconded by the Rev. J. H. Jellett:—

"That the Secretary of the Council of the Academy be requested to forward to the Secretary of the Shipowners' Association of Liverpool a copy of the President's Memorial to Lord Palmerston, and to ask for the co-operation of that body with the Royal Irish Academy."

A letter from J. Beete Jukes, Esq., was read, presenting twenty-one maps of the Geological Survey of Ireland by Sir R. J. Murchison, on the part of her Majesty's Government.

A geometrical projection of two-thirds of the sphere, by Lieutenant-Colonel H. James, R. E., &c, was presented.

The fragments of an iron sword, found near St. John's Point, county of Down, were presented by Major Brown.

The list of books presented to the Library since the last meeting was read.

Thanks were returned to the several donors.

Monday, May 25th, 1857.

JAMES HENTHORN TODD, D.D., President, in the Chair.

J. Huband Smith, LL.D., read a paper on the "History and Foundation, by Archbishop Marsh, of St. Patrick's Library, adjoining the ancient Archiepiscopal Palace of St. Sepulchre's."

Sir W. R. Hamilton, LL. D., read some remarks on the General Equation in Quaternions for Cones of the Third Order.

The Secretary presented, on the part of the Rev. Joseph Callwell, a sculptured slab, found in an old wall near Brookborough, with the following inscription:—

ōr dodunchad
p̄spit̄ hic

which, the President stated, was of the tenth or eleventh century, and signified—"A prayer for Dunchad, the Presbyter, here."

The thanks of the Academy were given to the Rev. Joseph Callwell for this donation to the Museum.

MONDAY, JUNE 8TH, 1857.

JAMES HENTHORN TODD, D.D., PRESIDENT, in the Chair.

DANIEL G. GRIOTT, ESQ., Captain C. P. Molony, Thomas O'Hagan, Esq., Bindon Blood Stoney, Esq., and James Whitehead, M.D., were elected Members of the Academy.

On the recommendation of the Council it was Resolved—

I. That the Academy do authorize the Treasurer to sell out such a sum as will produce £500 three per cent. Stock, and place it to the credit of the Cunningham Fund, thereby restoring that fund to the amount of £1643 19*s*. 6*d*., as per annual abstract of accounts of the Academy of the 31st of March, 1855,—the above sum of £500 Stock having been sold by mistake from the Cunningham Fund, instead of from the general Stock account of the Academy.

II. That the Academy do authorize the Treasurer to sell out such a sum from the funds as will pay the liabilities, £516 17*s*. 11*d*., incurred under various heads of expenditure since the year 1853.

READ,—The following recommendation of the Council:—

"That the annual grants of £100 made to the Library Committee and the Committee of Antiquities, respectively, shall be temporarily suspended."

Whereupon George Petrie, LL.D., proposed, and John Francis Waller, LL.D., seconded, the following amendment:—

"That the annual grants to the Library and Museum of £100, respectively, be suspended for the coming year."

The President declared the amendment to be carried.

The Secretary read the following correspondence:—

"*Royal Irish Academy, Dublin,*
"*April* 4, 1857.

"My Lord,—On the part of the Royal Irish Academy, I have the honour of addressing your Excellency to solicit your favourable consideration of the following request:—

"Your Excellency is aware that during the progress of the Ordnance Survey in this country it was the earnest endeavour of the distinguished officers employed in that great national work, in addition to the main objects contemplated by Parliament, to collect and preserve such local knowledge as might render the Survey subservient to other purposes. With this view, geological, statistical, and antiquarian researches were carried on, information was collected on the Fauna, the botany, and agricultural resources of each district, as far as was consistent with the more urgent duties of the Survey, and it was proposed to embody the materials thus brought together in County Memoirs.

"This admirable project was strenuously supported by the Royal Irish Academy, who saw in it an opportunity of making known, and of preserving from oblivion, information of the greatest value to science, history, and topography,—information which, if the design had been carried out as originally intended and begun, could not fail to have been most beneficial to the social progress of Ireland.

"But when the topographical delineation of the country was completed, and the invaluable Maps now so extensively useful were published, the Academy learned with regret that it was not thought necessary by the Government to continue the descriptive memoirs of the Irish counties.

"The geological and agricultural part of the contemplated work has since been, in a great measure, otherwise provided for, so that the interests of practical science have not suffered much, if at all, from its discontinuance. But the materials

collected for the illustration of local history and antiquities in each county have been made but little use of; nor are they at present in a situation where they can be conveniently consulted by Irish scholars. They are still kept at the office of the Survey in the Phœnix Park, and it would be very desirable now to have them removed to some more accessibly depository. They are of singular interest, having been collected at a period where traditions still lingered in districts now wholly altered in their character by emigration, the change that has taken place in the owners of the soil, the rapid growth of agricultural improvement, and the construction of railways. In many places it will be found that the descriptions and drawings preserved in these collections are now the only remaining record of monuments which connected themselves with our earliest history, and of the 'folk-lore' which the famine swept away with the aged sennachies who were its sole repositories.

"So long as there existed any probability of these documents being published, it was most proper that they should remain in the custody of the Ordnance department, under whose auspices they were collected. But it is now understood that the intention of publishing them in any form has been entirely and finally abandoned.

"I beg leave, therefore, respectfully to request that your Excellency may be pleased to recommend these collections to be removed to the Library of the Royal Irish Academy. In no other place can they be more conveniently accessible to the scholars best qualified to use them for the promotion of historical and archæological learning. One great branch of the Academy is devoted by our charter, as your Excellency is aware, to the studies which these manuscripts are so well adapted to assist. The Library is rich in the literature that will best illustrate them: it is in a central situation, accessible, and liberally thrown open to all competent scholars who seek for admission, as well as to our own Members; and as

the value of these collections is mainly due to the skill and learning of some distinguished ornaments of the Academy, whose services were given to the Survey for the purpose, I would humbly represent to your Excellency that no more appropriate depository can be found for the preservation of so valuable a monument of their intelligence and industry.

"I have, &c.,

(Signed) "JAMES H. TODD,

"*President of the Royal Irish Academy.*

"*To his Excellency the Lord Lieutenant.*"

"*Dublin Castle, June* 7, 1857.

"SIR,—With reference to your letter of the 4th of April last, I am directed by the Lord Lieutenant to acquaint you that a communication has been received from the Lords Commissioners of her Majesty's Treasury, stating that their Lordships have been in communication with the War department on the subject of the materials collected for the illustration of local history and antiquities in the several Irish counties during the progress of the Ordnance Survey in Ireland; and that Lord Panmure sees no objection to their transfer to the Royal Irish Academy; and that their Lordships have requested that the necessary steps may be taken for that purpose.

"I am, Sir, your obedient Servant,

"THOMAS A. LARCOM.

"*Rev. Dr. Todd,*

"*President of the Royal Irish Academy.*"

"*Ordnance Survey Office, Dublin,*

"*June* 8, 1857.

"SIR,—The Lords Commissioners of her Majesty's Treasury having sanctioned the transfer to the Library of the

Royal Irish Academy of the manuscripts collected during the progress of the Ordnance Survey for the illustration of local history and antiquities, in accordance with the request contained in your letter of 4th April to his Excellency the Lord Lieutenant, I am directed by Lieutenant-Colonel James, Royal Engineers, Superintendent of the Ordnance Survey, to inform you that the documents in question will be arranged and prepared for transmission to the Academy as early as practicable.

"I have the honour to be, Sir,

"Your most obedient, humble Servant,

"G. A. Leach,

"*Captain R. E.*

"*Rev. Dr. Todd, &c., President.*"

A vote of thanks to his Excellency the Lord Lieutenant and to her Majesty's Government for this important donation was passed by acclamation.

Monday, June 22nd, 1857.

JAMES HENTHORN TODD, D. D., President, in the Chair.

The President communicated the following paper by the Rev. Edward Hincks, on the Personal Pronouns in their most ancient forms:—

"I have treated of the personal pronouns in a paper read before the British Association in 1852, and more fully in a paper read before the Royal Irish Academy on the 26th of June, 1854, and printed in the twenty-third volume of the Transactions. Further researches have confirmed to their fullest extent all that I stated in the latter paper; but they have also enabled me to go further back into the history of these pronouns, so as to explain the forms in which they appear in the Hebrew future, as it is called, and in the four Assyrian tenses, which I mentioned at the close of my last paper as denoting transient action.

"The Assyrian pronoun of the first person singular is *anáku*, corresponding to the Hebrew *anóki;* and this is in reality, as I stated, a verb *an* combined with the true pronoun *áku* or *óki.* I have observed, however, that wherever the long *o* occurs in Hebrew, a contraction has taken place.* It represents *awa* or *ahwa;* the two vowels being separated by a sound similar to that represented by the Æolic digamma, and which ceased to be expressed in the later Assyrian, and in Hebrew, where a contraction did not take place, precisely as it ceased to be expressed in classical Greek. This digamma originally commenced the pronoun of the first person singu-

* So in the feminine plural. The Hebrew וֹת, *ót*, is in Assyrian *áhwat*, with the case-ending. For example, the genitive is—m. s. *danni*, f. s. *dannáti*, m. p. *danniti*, f. p. *dannáhwati*.

lar, which was *hwáku* at a more ancient period than *áku*. It also commenced the first person singular of all these tenses of verbs which had preformatives. The preformative of this person is *hwa* before a consonant, and the simple digamma before a vowel. Thus, 'I burned,' which in the later Assyrian was simply *ásrup*, was originally *hwásrup*. 'I sat,' which was in late Assyrian *úsib*, was originally *hwúsib*. This was probably pronounced in the same manner as the third person *yúsib*, 'he sat.' At any rate these two forms were represented alike to the eye, whether they were distinguished or not to the ear. The interchange of the sounds *hw* and *y* was not confined to the preformatives. The affix of the first person singular, which was originally *hwa*, was written *ya* in most Assyrian inscriptions of late date. It is true that in the great majority of instances where it is so written it is preceded by *i;* but the fact that the affix had become *ya* is shown by the abbreviated form which we meet with when a consonant precedes it. 'My father,' without the case-ending, is written *abi*, as well as *aba*. The former could not be a contraction from *abhwa*, but necessarily supposes a form *abya*. In the Semitic languages previously known, *i* is almost universal. The Ethiopic, however, has *ya;* and this is occasionally used in Arabic. None of these go back to the primitive form with the digamma.

"A question now arises,—Is this *hwa*, which was, as we have seen, at the same time the preformative of the first person singular in verbs, and the affix of the same person after nouns, in the most ancient period of the Assyrian language, an abbreviation of *hwáku*, the most ancient form of the independent pronoun. At the first glance, one would be tempted to say,—'Of course; can it be doubted?' And if we had merely the Assyrian and other Semitic languages, and the Indo-European languages, to guide us in our investigations, it would, I grant, be unnatural to doubt it. We have, however, other grounds on which we can form an opinion. We

can go back to a more ancient language than any of those that I have mentioned; and, looking to it, I have no hesitation in answering the above question by,—'Certainly not.' The form *hwa* is the more ancient; and *hwaku*, the common parent of the Indo-European, Semitic, and Egyptian forms, is a derivative from this. We are enabled to analyze it by means of the bilingual tablets in the British Museum, which contain words and sentences in a peculiar language, with their interpretations in Assyrian. This peculiar language may be called Accadian—a name which can cause no ambiguity, and which has been suggested by Sir Henry Rawlinson, who, however, describes it as a Hamitic language, cognate to the Egyptian, which it certainly is not. It might be called with great propriety Chaldean, because it was used to a great extent in the astronomical tablets, which all authorities agree in ascribing to the Chaldeans; only that the name Chaldean is unfortunately preoccupied to designate the language in which parts of the books of Ezra and Daniel are written, which was a Semitic dialect. The Accadian language was derived from the common parent of the Indo-European and Semitic languages; and by comparing its forms with those of these languages, we may recover some portions of the primitive language of mankind. Now the Accadian forms of the pronoun of the first person are *mun* for the independent pronoun, or nominative, and *mu* for the affix 'my.' The *n* which is added to the nominative appears also in the nominative *in* 'he,' as compared with *i*, the Semitic preformative, which again appears as the root of the Latin *is*, *s* being a case-ending, and of *hic*, i. e. *hi-ce*, 'he here.' It is also the German *er*, *r* being a case-ending; and it is our own *he*. It is indeed very curious how like an Assyrian word sometimes is to its exact English equivalent. Compare, for example, *i-pruch* with its equivalent, 'he broke.' The roots are cognate; as appears still more clearly in the verbal noun, *pirich*, 'a breach;' and the pronouns are all but identical. In Accadian the pronoun

would be *in* prefixed to the verb; but I am unable to say what this verbal root would be. It has been out of my power to see more than a very small proportion of the bilingual tablets in the Museum. It appears from what has been said that the *n* at the end of the Accadian *mun*, 'I,' is, like that at the end of *in*, 'he,' a termination peculiar to the Accadian language. The radical part of the pronoun is *mu*. The passage of the digamma into *m* is admitted by all who have treated of it in Greek. The Assyrians constantly confounded the sounds of *w* and *m;* and in Hebrew the digamma was represented by מ when it did not disappear in א, or pass into י. Of the last change there are instances that cannot be questioned. It has been often remarked that יַיִן is the Greek Ϝοῖν-ος, the Latin *vin-um*, our own 'wine.' In like manner, יָם, 'a sea,' was *hwam*. The old Assyrian form was *hwámat;* see § 14 of my former paper on the Pronouns, where the feminine form of similar words is noted. As for א, it is the most frequent representative of the digamma. It represents it in every case where it is a preformative; and in most cases, if not in every case, where it is a radical. The conversion of the digamma into מ is most remarkable in the word for 'water.' The primitive word was *hwa*, which sound was expressed by a character intended to represent *falling rain*, . More commonly this word was doubled, giving *hwa* . *hwa*. In Hebrew we have *mô* for *mahwa*, and also *may-* and *mâm-*; the first digamma being always converted into *m;* while the second was sometimes contracted in the manner already described; sometimes changed into *y*, and sometimes into *m*. The Hebrew generally expressed this as a plural; and the primitive *hwa-hwa* is, in fact, a plural. The Indo-European nations generally adopted the double form for the noun; as in the Gothic *ahwa*, the Latin *aqua*, &c.; while the simple form was used for the verb 'to wet' and its derivatives—ὕ-ω, ὕ-δωρ, *u-dus*, to *we-t*, *wa-ter*, &c. In *amnis* the second digamma is converted into an *m*. In *avon*, *awen*, &c., we have

more ancient forms of this derived noun than the Latin, the second digamma being here retained. I believe the former of the two digammas was always dropped in those Indo-European forms which adopted the redoubled primitive, though retained when the simple primitive was used.

"To return from this digression. It appears pretty evident that either *hwa* or *hwu* was the primitive form of the pronoun of the first person singular; but a new question arises—what was the *ku* which appears in combination with this in all the Semitic and Indo-European languages? This question is, I think, capable of being answered in a most satisfactory manner. In the Accadian language *ku* is a post-position, equivalent to the Assyrian preposition *ana*, originally *hwana*. It signified 'to' or 'for,' or, in fact, 'here,' as *ad* in *adsum*. *Hwá-ku* was then 'I here;' this *ku* was etymologically connected with the Latin *cis*, *citra*, and with the *c* in *hic*, which is, as I have already stated, *hi-ce*, 'he here;' a similar form to *hwá-ku*, but of much more recent origin.

"This being settled, there are two reasons why *hwu*, and not *hwa*, is to be regarded as the primitive form. In the first place *hwa* was the primitive word for 'water,' and we cannot suppose that 'water' and 'I' were expressed by the same word. This would be in the highest degree improbable. Secondly, if *hwa* were the primitive form, no good reason could be given for its having been converted into *hwu*, from which the Accadian *mu* must have been derived; whereas *hwu* might easily pass into *hwa* (long *u*, as in *bull*, into the natural vowel *a*, as in *America*) when shortened for the preformative and the affix,—neither of which takes the accent, and both of which occasionally drop the vowel altogether, as in *hwu-sib*, where the *u* is radical; and *abi* for *abya*, and that for *abhwa*—instances that have been already given. It is true that this does not account for the form *hwáku*, where the *a* is long and has the accent. That may, however, be accounted for on a different principle. The Accadians had the very opposite

feeling to what the Turks and Tartars now have as to the repetition of vowels. The latter assimilate vowels to others in the same word, but the Accadians made them different when they would naturally be similar. The Accadians usually terminated their adjectives in *a;* but they changed the *a* into another vowel, when the vowel of the first syllable was *a*, followed by but a single consonant. They said *jida*, *gula*, and even *danga*, but they said *qadu*, in place of *qada*. On a like principle the primitive people converted *hwu-ku* into *hwáku* when they combined the two words into one.

"The progressive changes in the pronoun of the first person singular are, then, these:—

"The primitive form was HWU, 'I,'

from which came HWA-KU, for *hwu-ku*, 'I here.'

"From the former of these is immediately derived the Accadian affix *mu;* which, with a final nasal, became the nominative singular *mun*. From these the different Ugrian forms are derivable.

"From the same *hwu* is derived, by shortening or omitting the final vowel, the Semitic preformative and affix; of which the forms first in use were *hwă* and *hw'*, softened into *yă* and *ă*, and into *i*, *a*, or a mere nullity.

"From the same *hwu* are again derived the various forms of the oblique cases of the singular pronoun in all the Indo-European languages, the personal endings in all the tenses and numbers of verbs, and several dual and plural forms of the pronoun, both in the nominative and in the oblique cases. These it is unnecesary to develop.

"From the latter form, in the primitive language, we have, by dropping the digamma, AKU, the parent form of all the Indo-European nominatives. The consonant is preserved in Gothic, changed into *g* in the classical languages, and into *sh* or *z* in Lithuanian and Sclavonic. The first vowel has degenerated into *i* in all the Gothic and Teutonic forms; *a* is preserved in the other families, for the classical *e* is only a

modification of it. The final *u* is preserved in the classical languages alone. The Perso-Sanskrit forms are of far later date than those of the European languages, and appear to be derived from the Sclavonic; a final nasal being added, apparently in imitation of the Ugrian *n*.

"The Semitic forms are likewise derived from *hwáku;* their common parent being *hwan-hwáku*, properly *adsum*, as I showed in my former paper. The double addition in the so-called Semitic languages of a prefix and a suffix, of which the meanings are almost identical, is very remarkable. It is clear that the suffix was first added; and that, when the prefix was added, the two syllables which followed it were considered as one word, the meaning of the suffix being no longer recollected. This can only be accounted for either by supposing an extremely long interval between the addition of the suffix and that of the equivalent prefix, or by supposing a miraculous confusion to have taken place in the views of the people with respect to language in the interval between these two additions having been made. I have observed facts indicative of such an occurrence, which are easily explained by the admission of its having existed, and scarcely, if at all, to be accounted for on any other supposition,—but I must forbear stating them at present. The study of these bilingual tablets cannot fail to throw great light on the early history of languages; but it would be rash to draw inductions from what has yet become known to me. As to the pronoun of the first person singular, I am satisfied that I am well informed as to the facts, but not so as to the other pronouns. Here, therefore, I must close what I have to say.

"Edward Hincks.

"*Killyleagh*, *June* 18, 1857."

Sir William R. Hamilton read a paper on a certain harmonic property of the envelope of the chord connecting two corresponding points of the Hessian of a cubic cone.

Sir William R. Hamilton communicated a paper by John T. Graves, Esq., on a fundamental theorem respecting congruences, affecting a class of complex integers which involve the imaginary cube roots of unity.

The President presented to the Academy:—

1. On the part of the Marchioness of Thomond, an ancient martel, or battle-axe handle, said to have belonged to Brian Boroimhe.

2. On the part of Rev. J. Alder, Sund Glebe, Downpatrick, a collection of Roman coins, found near Downpatrick, viz.:—

(1.) Second brass of Tiberius.
(2.) ,, ,, Hadrian.
(4.) ,, ,, Philippus, Sen.
(5.) ,, ,, Max. Hercules.
(6.) Third brass of Licinius.
(7.) ,, ,, Constantine (the Great).
(3.) Large brass of M. Antoninus.
(8.) Brass colonial coin of Domitian (?), washed with silver.

3. On the part of Captain George P. Heathcote, a large brass brooch, worn by the women of Kanawar in the western Himalayas.

4. On the part of Alexander Falls, Esq., two deeds of James II. and Charles II., the first bearing the autograph of James, when he was Duke of York and Earl of Ulster; and the second attested by Jas. Plunkett.

W. R. Wilde, Esq., presented to the Academy:—

1. On the part of William Wakeman, Esq., some ancient quern stones; a part of a stone cross found at Donoughmore; and part of the market-cross at Navan.

2. On the part of Mrs. Robert Ball, a small bust of the late Very Rev. Henry Dawson, Dean of St. Patrick's; a bronze palstave; a banker's stamp; a curious brass spur; and

a carving in sea-horse tooth representing a bear attacking a Greenlander,—supposed to have been used as a chess-man.

3. On his own part, a large collection of animal remains found near Dunshaughlin, county of Meath.

W. R. Wilde, Esq., exhibited:—

1. On the part of Henry Grattan, Esq., a bronze or brass two-handled cup, and a large fragment of wrought iron, found at Holycross.

2. On the part of Sir Benjamin Chapman, Bart., a selection from his collection of Irish antiquities, to be deposited in the Museum of the Academy for the present.

The following recommendations of the Council were adopted:—

1. That a subscription list be opened among the Members of the Academy to defray the expense of a conversazione to the British Association.

2. That a special Meeting of the Academy be held on Monday, August 24 next, for the election of new Members preparatory to the Meeting of the British Association.

MONDAY, AUGUST 24TH, 1857. (Extraordinary Meeting.)

JAMES HENTHORN TODD, D.D., President, in the Chair.

LORD STEWART DE DECIES; Lord Massareene and Ferrard; Right Hon. Richard Atkinson, Lord Mayor; Denis Crofton, Esq., A.B.; Robert Corbet, Esq.; Samuel A. Cusack, Esq.; George Victor Du Noyer, Esq.; Alfred Furlong, Esq.; Henry Grattan, Esq.; Thomas Hayden, Esq.; George Paul Helsham, LL. D.; Rev. Alfred T. Lee, A. M.; Major-General Sir Charles O'Donnell; William K. Sullivan, Esq.; E. Percival Wright, Esq., were elected Members of the Academy.

The Secretary of the Council read the following extracts from the Minutes of the Council of 7th August:—

"Part I. of the Catalogue of the Museum having been presented by Mr. Wilde,—

"RESOLVED,—That the thanks of the Council be voted to W.R. Wilde, Esq., and that the portion of the Catalogue now printed be presented to the Academy at their next meeting, and that he be requested, if he should think fit, to lay before the Academy the Report read by him to the Council."

"That it be recommended to the Academy to place 100 copies of the Catalogue at the disposal of Mr. Wilde."

And also,—

"That each Member be entitled to a copy of the Catalogue at cost price, and that the price to be charged to the public be settled by a Committee, consisting of the President, Mr. Gilbert, and Mr. Wilde."

The President explained that the Committee had considered the prices at which the Catalogue should be sold, and had decided that the price to Members should be 4*s*., and to the public 6*s*., each copy.

Mr. Wilde brought before the Academy a statement of the plan which he had adopted in the formation of the Catalogue, the First Part of which he laid on the table.

The Secretary then moved, that the recommendations contained in the Resolutions of the Council of 7th August, just read, be adopted by the Academy, and the President having taken the vote of the Academy, declared that they were carried.

It was moved by Sir Colman O'Loghlen, and seconded by Thomas E. Beatty, M. D., and resolved:—

"That the Board of Works be requested to take immediate steps to have the Museum properly ventilated, if possible before next Saturday."

It was moved by the Lord Chief Baron, and seconded by Charles Benson, M. D., and resolved:—

"That the marked thanks of the Academy be given to Mr. Wilde for the zealous and effective way in which he has exerted himself in the arrangement of the Museum, and the formation of the Catalogue which he has presented to the Academy this evening."

Mr. Wilde presented:—

On the part of Dr. Kelly, of Mullingar, a collection of antiquities.

On the part of Mr. Du Noyer, a shoe-spur, and a collection of heel-ball rubbings from certain ancient monuments in Ireland.

The Secretary presented, on the part of Arthur R. Nugent, Esq., three jade-stone celts, and a small idol from New Zealand.

The Academy then adjourned.

APPENDIX.

No. I.

ACCOUNT

OF

THE ROYAL IRISH ACADEMY,

FROM 1ST APRIL, 1853, TO 31ST MARCH, 1854.

THE CHARGE.

	£	s.	d.	£	s.	d.
To Balance in favour of the Public on 1st April, 1853, ...	. . . .			198	11	0
Parliamentary Grant for 1853, ...	300	0	0			
Quarterly Warrants from Treasury, . .	110	3	3			
Total from Government, .				410	3	3
INTEREST ON STOCKS:						
One year's on £1643 19 6 at 3¼ ₩ Cent.	53	8	8			
Half-year's on 717 1 7 at 3 ,, .	10	15	1			
Half-year's on 1229 14 5 at 3 ,, .	18	8	11			
Total Interest on Stocks, .				82	12	8
To TRANSACTIONS AND PROCEEDINGS sold, .	. . . .			23	18	2
LIFE COMPOSITIONS:						
J. Huband Smith, A. M., ...	6	6	0			
Francis R. Davies, Esq., ...	21	0	0			
Roger C. Walker, Esq., ...	6	6	0			
James Pim, Esq., ...	6	6	0			
Total Life Compositions, .				39	18	0
ENTRANCE FEES (£5 5s. each):—Rev. B. H. Blacker; Major J. Bonner; J. E. Butler; J. T. R. Colclough; E. Curry; F. R. Davies; C. Domvile; Rev. W. Fitz-						
Forward,				755	3	1

	£	s.	d.	£	s.	d
Brought forward,				755	3	1
gerald; Rev. R. Ferguson; J. Lentaigne, M. D.; J. J. M'Carthy; J. R. O'Flanagan; J. B. Pratt; A. Read, M. D.; H. H. Stewart, M. D., ...	.	.	. .	78	15	(
Annual Subscriptions for 1852, paid:—						
F. Barker, M. D.; Sir P. Crampton, Bart.; D. Dunlop; E. Getty; G. A. Hamilton, M. P.; Rev. W. Lee; William Monsell, M. P.; W. J. O'Driscoll,	16	16	0			
Annual Subscriptions for 1853, paid:—						
Rev. I. G. Abeltshauser; R. Adams, M. D.; Rev. J. Alcorn; W. Andrews; Signor Angeli; J. Anster, LL. D.; Abr. W. Baker; W. O. Barker, M. D.; E. Barnes; Sir M. Barrington, Bart.; T. J. Beasley; T. E. Beatty, M. D.; H. C. Beauchamp, M. D.; J. Bell; Ven. M. G. Beresford; P. Bevan, M.D.; E. Bewley, M. D.; D. F. Brady, M. D.; F. W. Burton; S. Carter; T. Cather; H. Clare; F. V. Clarendon; J. Claridge; E. S. Clarke, M. D.; F. Codd; M. Collis; A. Cooke; Sir P. Crampton, Bart.: J. Davidson; R. Deasy; Archdeacon of Dublin; Durham Dunlop; J. C. Egan, M. D.; James S. Eiffe; S. Ferguson; A. Ferrier, Jun.; J. Finlay, LL. D.; C. Fleming, M. D.; C. S. Fortescue, M. P.; R. Fowler; Capt. G. A. Frazer; H. Freke, M. D.; Rev. J. A. Galbraith; E. Getty; J. Gibson; W. Goold, M.P.; S. Gordon, M. D.; Dean of Kildare; W. Gregory, M. D.; D. Griffin, M. D.; W. Grimshaw, M. D.; T. Grubb; G. A. Hamilton, M. P.; C. Hanlon; W. H. Hardinge; Rev. S. Haughton; W. Hogan; E. Hutton, M. D.; W. N. Irwin; Capt. H. James; Sir J. Kingston James, Bart.; Rev. J. H. Jellett; F. M. Jennings; H. H. Joy; T. F. Kelly, LL.D.; G. A. Kennedy, M. D.; H. Kennedy, M. D.; W. T. Kent; R. Law, M. D.; W. R. Le Fanu; W. T. Lloyd; Rev. G.						
Forward,	16	16	0	833	18	1

	£	s.	d.	£	s.	d.
Brought forward,	16	16	0	833	18	1
Longfield; M. Longfield, LL.D.; W. Longfield; R. D. Lyons, M.B.; J. S. Macdonnell; Rev. R. J. M'Ghee; J. M'Mullen; R. R. Madden; J. Magee; A. G. Melville, M. D.; J. Mollan, M.D.; William Monsell, M. P.; D. Moore; W. T. Mulvany; James Sheridan Muspratt; J. Moore Neligan, M. D.; John O'Donovan, LL. D.; W. J. O'Driscoll; N. P. O'Gorman; J. Osborne, M. D.; J. Owen; J. Patten, M. D.; Rt. Hon. Chief Baron; J. E. Pigot; J. Pim; A. T. Preston; W. A. Purdon; Rev. J. Reid; R. Reid, M. D.; M. R. Sausse; Rev. J. B. Sayers; O'Neale Segrave; F. J. Sidney, LL. D.; A. Smith, M. D.; C. Smith; J. H. Smith; H. Smyth; R. W. Smith, M. D.; Sir T. Staples, Bart.; M. H. Stapleton; D. P. Starkey; Lord Talbot de Malahide; M. E. Talbot; Very Rev. J. J. Taylor, D. D.; R. Tighe; R. W. Townsend; T. J. Tuffnell; C. Vignoles; R. C. Walker; J. F. Waller, LL. D.; C. T. Webber; Rev. J. Wills; Right Hon. J. Wynne; G. Yeates, . .	264	12	0			
Annual Subscriptions for 1854, paid:—						
Wm. Andrews; W. O. Barker, M. D.; Archdeacon of Ardagh; W. Brooke; J. Burrowes; Archdeacon of Cashel; Fleetwood Churchill, M.D.; Dean of Clonmacnoise; Adolphus Cooke; M. P. D'Arcy; William Dargan; M. Donovan; C. Doyne; Archbishop of Dublin; W. Edington; Baron Farnham; Lord W. Fitzgerald; Rev. W. Fitzgerald, D. D.; H. Freke, M. D.; W. Gregory, M. D.; T. Grubb; C. W. Hamilton; F. M. Jennings; J. C. Kenny; C. C. King, M. D.; A. Leared, M.B.; Rev. A. Leeper; J. Lentaigne; F. L'Estrange; M. Longfield, LL.D.; A. J. Maley; A. R. Nugent; M. M. O'Grady, M. D.; Dean of St. Patrick's; A. Read, M. D.; G. Sanders; Hon. T. Vesey; C. Vignoles,	79	16	0			
Total Annual Subscriptions,				361	4	0
Forward,				1195	2	1

	£	s.	d.	£	s.	d.
Brought forward,				1195	2	1
Subscriptions for the Purchase of Gold Torques.						
Ven. Archdeacon Strong, ...	. .	. .	.	1	0	0
House in Grafton-street.						
Alliance Gas Company's Balance of Purchase of House in Grafton-street,	. .	. .	.	475	0	0
Subscription for the Purchase of Domnach Airgid.						
J. Huband Smith, Esq., ...	. .	. .	.	1	0	0
Cancelled Stamps, ...	. .	. .	.	2	11	3
Sale of Meteorological Instruments.						
George Yeates, Esq., ...	. .	. .	.	2	12	6
Contingencies.						
Trinity College, for Expenses on Books,	. .	. .	.	0	2	0
Total Amount of Charge, . .	. .	. .	.	1677	7	10

THE DISCHARGE.

ANTIQUITIES.		£ s. d.	£ s. d.
Carroll, B., sundries,		0 10 6	
Connell, James, ,,		0 10 0	
Conroy, Mary, ,,		0 17 0	
Devitt, James, ,,		0 3 0	
Gray, James, ,,		0 2 0	
Hanly, P., ancient bell,		2 0 0	
Strange, J. F., sundries,		0 5 0	
Underwood, Jas., ,,		1 10 0	
Wakeman, William, ancient bell,		2 0 0	
Walker, R. F.,		0 2 6	
Webb, Mrs., bottles,		2 0 0	
Total Antiquities purchased,			10 0 0
BOOKS, PRINTING, AND STATIONERY.			
Boone and Co., Linnean Transactions,	£2 15 0		
Boone and Co., Subscriptions to Camden Society,	2 0 0		
Boone and Co., Taylor's Memoirs,	6 12 0		
		11 7 0	
Carroll, B., Sir Wm. Betham's papers,		5 0 0	
Chamney, Robert M., reporting meetings for Proceedings,		14 14 0	
Clibborn, Edw., expense of removing books from the late Wm. E. Hudson's house,		0 19 0	
Gill, M. H., printing Transactions, vol. xxii. part 4,	£134 17 0		
Ditto, vol. v. part 3, Proceedings,	62 14 5		
Ditto, miscellaneous printing,	22 13 5		
		220 4 10	
Hodges and Smith, books, 1853–54,		30 16 2	
Kelly and Co.,		0 10 0	
Kelly, Thomas, old maps of Ireland,		0 5 0	
Long, Joseph, Irish MSS.,		3 0 0	
O'Daly, J., books,		1 4 6	
Forward,		288 0 6	10 0 0

	£	s.	d.	£	s.	d.
Brought forward,	288	0	6	10	0	
Oldham, William, wood engravings, . .	3	19	6			
Quaid, James, Dublin Directory, . . .	0	12	6			
Reeves, Wm., subscription to the Lives of the Cambro-British Saints, ...	1	2	0			
Tallon, John, Jun., stationery, ...	3	12	2			
Total amount of Books, Stationery, &c.,				297	6	8
Repairs of House.						
Bray, John, cleaning ash-pit, ...	0	6	0			
Murphy, James, sweeping chimneys, . .	0	13	0			
Paving Corporation, for cleansing sewer, .	0	11	4			
Total Repairs of House, ...				1	10	4
Taxes and Insurance.						
Globe Insurance Company, ...	8	10	6			
National Insurance Company, ...	12	7	0			
Ministers' money, ...	2	15	5			
Parish cess, ...	0	15	7			
Pipe-water, ...	5	0	11			
Property tax, ...	1	12	8			
Total Taxes and Insurance, . . .				31	2	1
Furniture and Repairs.						
Boswell, James, paper for lining trays, .	0	17	6			
Carroll, B., busts, ...	1	5	0			
Casey, P., repairing locks, ...	0	7	0			
Jones, J. F., stamp-press, ...	1	1	0			
Pike, William H., fire-screens, ...	2	5	0			
Todd and Co., furniture for hall porter, .	3	3	2			
Yeates, George, beam, stand, and weights,	6	16	0			
Total Furniture and Repairs, .				15	14	8
Salaries, Wages, Etc.						
Ball, Robert, LL. D., Treasurer, . . .	21	0	0			
Clibborn, Edward, Clerk and Curator, .	150	0	0			
Drummond, Rev. W. H., D.D., Librarian,	21	0	0			
Graves, Rev. Charles, D. D., Secretary of Council, ...	21	0	0			
Leigh, Simon, porter, ...	24	13	9			
Murphy, J., porter, ...	7	16	0			
O'Brien, Thomas, messenger, ...	39	0	0			
Todhunter, Isaac, Accountant, ...	52	0	0			
Total Salaries, Wages, &c., . . .				336	10	0
Forward,				692	3	9

	£	s.	d.	£	s.	d.
Brought forward,				692	3	9
CONTINGENCIES.						
Clibborn, Edward, allowance for sundries used in cleaning house, for the year 1853-54, ...	10	0	0			
Expenses attendant on Great Exhibition,	27	3	9			
Freight and charges on books, ...	13	14	6			
Postage stamps and postage, ...	7	2	4			
Petty charges, ...	5	15	0			
Total Contingencies, ...				63	15	7
COALS, GAS, ETC.						
Alliance Gas Company, gas and coke, . .	11	7	0			
Holmes, Thomas, 23 tons coals, ...	18	11	6			
Lambert, J., candles, ...	0	7	1			
Stephens, John, 10 tons coals, ...	11	5	0			
Total amount of Coals, Gas, &c., . . .				41	10	7
GOLD TORQUES.						
Edward Clibborn, on account of his purchase of two gold torques for the Academy, on 3rd October, 1848, ...	. . .			1	0	0
BOARD OF PUBLIC WORKS.						
On account of rent, ...	. . . .			146	17	8
EXPENDITURE ON HOUSE, GRAFTON-STREET.						
Seymour and Webb, portion of costs in getting renewal of a life in lease, . .	21	0	0			
Wallace, W. B., and Son, for costs on lease,	23	16	3			
				44	16	3
STOCK PURCHASED.						
£512 12 7—3 per Cents., cost, ...	. . . .			500	11	6
EXPENDITURE ON HOUSE DAWSON-STREET.						
E. Clibborn, for cleaning house, from 3rd April, 1852, to 26th November, 1853,	44	0	0			
O'Brien, M., for carpenter's work, . . .	65	5	11			
				109	5	11
FITTINGS OF MUSEUM, 19, DAWSON-STREET.						
O'Brien, M., carpenter's work, ...	. . . .			23	15	10
METEOROLOGICAL EXPENDITURE.						
Yeates, George, repairing instruments, .	. . . .			1	10	4
Total Discharge, ...	. . . .			1625	7	5
Balance in favour of the Public, .	. . . .			52	0	5
TOTAL AMOUNT OF CHARGE, . .	. . . .			1677	7	10

GENERAL ABSTRACT OF THE MONTHLY ACCOUNTS OF THE ROYAL IRISH ACADEMY,

AS FURNISHED TO AUDIT OFFICE, FROM 1st APRIL, 1853, TO 31st MARCH, 1854, INCLUSIVE.

Dr.	£	s.	d.
To Balance, 1st April, 1853,	198	11	0
To Government Grant and Treasury Allowance,	410	8	8
To Interest on Stock,	82	12	8
To Transactions and Proceedings sold,	23	18	2
To Life Compositions,	39	18	0
To Entrance Fees,	78	15	0
To Annual Subscriptions,	361	4	0
To Gold Torques,	1	0	0
To House, Grafton-street,	475	0	0
To Subscription to Domnach Airgid,	1	0	0
To Cancelled Stamps,	2	11	3
To Meteorological Instruments sold,	2	12	6
To Contingencies,	0	2	0
	1677	7	10

Cr.	£	s.	d.
By Books, Printing, &c.,	297	6	8
By Antiquities,	10	0	0
By Repairs of House,	1	10	4
By Taxes and Insurance,	31	2	1
By Furniture and Repairs,	15	14	8
By Salaries, Wages, &c.,	336	10	0
By Contingencies,	63	15	7
By Coals, Gas, &c.,	41	10	7
By Gold Torques,	1	0	0
By Board of Public Works,	146	17	8
By House, Grafton-street,	44	16	3
By Government Stock,	500	11	6
By Expenditure on House, Dawson-street,	109	5	11
By Fitting up of Museum,	23	15	10
By Meteorological Expenditure,	1	10	4
	1625	7	5
By Balance indebted 31st March, 1854,	52	0	5
	1677	7	10

The Treasurer reports, that there is to the credit of the Academy, in the Bank of Ireland, £1229 14*s.* 5*d.* in 3 per cent. Consols, and £1643 19*s.* 6*d.* in $3\frac{1}{4}$ per cent. Government Stock, the latter known as the Conyngham Fund.

31*st March*, 1854.

(Signed), ROBERT BALL,
Treasurer.

No. II.

ACCOUNT

OF

THE ROYAL IRISH ACADEMY,

FROM 1ST APRIL, 1854, TO 31ST MARCH, 1855.

THE CHARGE.

	£ s. d.	£ s. d.
To Balance in favour of the Public on 1st April, 1854, ...	. . . .	52 0 5
Parliamentary Grant for 1854, ...	300 0 0	
Quarterly Warrants from Treasury, . .	175 14 7	
Total from Government, .		475 14 7
INTEREST ON STOCKS:		
One year's on £1643 19 6 at 3½ ℔ Cent.	53 8 7	
One year's on 1229 14 5 at 3 „ .	36 17 10	
Total Interest on Stocks, .		90 6 5
TRANSACTIONS AND PROCEEDINGS sold, .	. . . .	1 6 8
LIFE COMPOSITIONS:		
Rev. Robert Carmichael, ...	21 0 0	
The Archbishop of Dublin, ...	6 6 0	
Rev. Robert Ferguson, LL.D., . . .	15 15 0	
Robert Reid, M.D., ...	6 6 0	
William R. Wilde, Esq., ...	21 0 0	
Total Life Compositions, .		70 7 0
ENTRANCE FEES (£5 5*s.* each):—Rt. Hon. F. Blackburne; C. Brady; Sir B. Burke; R. Butcher; Rev. R. Carmichael; A. Carte, M.D.; Rev. O. W. Moore; J. H. Owen; P. Neville; E. Senior, . . .	. . . .	52 10 0
Forward,		742 5 1

	£	s.	d.	£	s.	d.
Brought forward,				742	5	
ANNUAL SUBSCRIPTIONS FOR 1852, PAID:— J. Aldridge, M. D.; W. C. Dobbs; Sir C. Fox; A. Lyle; R. A. Wallace; Hon. and Rev. W. Wingfield, ...	12	12	0			
ANNUAL SUBSCRIPTIONS FOR 1853, PAID:— J. Aldridge, M. D.; W. Armstrong; W. Barker, M.B.; M. Barry; D. J. Corrigan, M. D.; Rev. R. V. Dixon; W. C. Dobbs; Earl of Enniskillen; Sir C. Fox; W. N. Hancock, LL. D.; J. K. Ingram, LL.D.; P. Jones; G. Lefroy; A. Lyle; Rev. E. Marks, D.D.; T. Oldham; J. L. Rickards; V. Scully, M. P.; W. Stokes, M. D.; R. A. Wallace; R. C. Williams, M. D.; Hon. and Rev. W. Wingfield, ...	46	4	0			
ANNUAL SUBSCRIPTIONS FOR 1854, PAID:— Rev. I. G. Abeltshauser, LL. D.; R. Adams, M. D.; Rev. J. Alcorn; J. Aldridge, M. D.; J. Anster, LL. D.; W. Armstrong; J. Ball, M. P.; F. Barker, M. D.; W. Barker, M. B.; E. Barnes; Sir M. Barrington, Bart.; H. C. Beauchamp, M. D.; P. Bevan, M. D.; E. Bewley, M. D.; Rev. B. H. Blacker; Major J. Bonner; D. F. Brady, M. D.; D. Brereton, M. D.; J. E. Butler; E. Cane; H. Carlile, M. D.; S. Carter; T. Cather; Sir B. I. Chapman, Bart.; H. Clare; F. Clarendon; J. Claridge; E. S. Clarke, M. D.; F. Codd; M. Collis; D. J. Corrigan, M. D.; E. Curry; J. Davidson; R. Deasy; Rev. R. V. Dixon; W. C. Dobbs; W. Drennan; Archdeacon of Dublin; Viscount Dungannon; D. Dunlop; J. C. Egan, M. D.; J. S. Eiffe; Earl of Enniskillen; S. Ferguson; A. Ferrier, Jun.; J. Finlay, LL. D.; G. Fitzgibbon; C. Fleming, M. D.; L. E. Foot; Sir C. Fox; Capt. G. A. Frazer; Rev. J. A. Galbraith; J. Gibson; W. Goold, M.P.; S.						
Forward,	58	16	0	742	5	

	£	s.	d.	£	s.	d.
Brought forward,	58	16	0	742	5	1
Gordon, M. D.; Dean of Kildare; D. Griffin, M. D.; W. Grimshaw; W. N. Hancock, LL. D.; C. Hanlon; W. H. Hardinge; Rev. S. Haughton; W. Henn; W. Hogan; E. Hutton, M. D.; J. K. Ingram, LL. D.; Capt. H. James; Sir J. K. James, Bart.; Rev. J. H. Jellett; P. Jones; H. H. Joy; T. F. Kelly, LL. D.; W. Kelly, M. D.; G. A. Kennedy, M. D.; H. Kennedy, M. D.; W. T. Kent; R. Law, M. D.; W. R. Le Fanu; G. Lefroy; W. T. Lloyd; Rev. G. Longfield; M. Longfield, LL. D.; A. Lyle; Robert D. Lyons, M. B.; J. J. Mac Carthy; A. H. Mac Clintock, M. D.; J. S. Macdonnell; W. Mac Dougall; R. R. Madden, M. D.; J. Magee; Rev. E. Marks; G. M. Miller; J. Mollan, M. D.; C. Moore; D. Moore; W. T. Mulvany; J. S. Muspratt; J. M. Neligan, M. D.; J. O'Donovan, LL. D.; N. P. O'Gorman; T. Oldham; J. Osborne, M. D.; J. Owen; J. Patten, M. D.; J. E. Pigot; A. T. Preston; W. A. Purdon; R. Reid, M. D.; J. L. Rickards; G. Roe; M. R. Sausse; Rev. J. B. Sayers; V. Scully, M. P.; O'Neale Segrave; F. J. Sidney, LL. D.; A. Smith, M. D.; C. Smith; H. Smyth; R. W. Smith, M. D.; Sir T. Staples, Bart.; M. H. Stapleton; D. P. Starkey; H. H. Stewart, M. D.; W. Stokes, M. D.; Lord Talbot de Malahide; R. W. Townsend; T. J. Tufnell; R. A. Wallace; J. F. Waller, LL. D.; R. C. Williams, M. D.; Rev. J. Wills; Hon. and Rev. W. Wingfield; Right. Hon. J. Wynne, G. Yeates, ...	281	8	0			
ANNUAL SUBSCRIPTIONS FOR 1855, PAID:—						
C. Brady; J. Burrowes; Sir B. Burke; E. Cane; F. Churchill, M. D.; J. T. R. Colclough; Archdeacon of Cashel; Dean of Clonmacnoise; C. Domville; M. Do-						
Forward,	340	4	0	742	5	1

	£	s.	d.	£	s.	d.	£	s.	d
Brought forward,				340	4	0	742	5	
novan; C. Doyne; W. Drennan; Archdeacon of Dublin; Lord Farnham; Rev. W. Fitzgerald, D.D.; C. Hanlon; W. Henn; W. Hogan; W. Kelly, M.D.; J. C. F. Kenny; C. C. King, M.D.; J. J. Mac Carthy; A. J. Maley; J. Mollan, M.D.; C. Moore; A. R. Nugent; N. P. O'Gorman; Dean of St. Patrick's; A. Read, M. D.; Lord Talbot de Malahide; Hon. T. Vesey; C. Vignoles, . . .				67	4	0			
Total Annual Subscriptions, .							407	8	
Subscriptions towards the Purchase of Gold Ornaments found in Co. Clare.									
His Excellency the Lord Lieutenant, ...	£10	0	0						
His Grace the Lord Primate, ...	10	0	0						
Most Noble the Marquis of Lansdowne, ...	10	0	0						
Right Hon. Sir John Young,	5	0	0						
Rev. Dr. Renehan, . . .	1	0	0						
Anon, ...	1	0	0						
Received from Subscribers not Members of the Academy, ...				37	0	0			
Robert Ball, LL. D., . .	5	0	0						
John R. Corballis, Esq., .	3	0	0						
Hon. Justice Crampton, .	1	0	0						
Eugene Curry, Esq., . .	1	0	0						
Joseph Dickinson, M. D., .	1	1	0						
James Gibson, Esq., . .	2	0	0						
Dennis H. Kelly, Esq., . .	1	0	0						
James Magee, Esq., . . .	1	0	0						
Rev. R. M'Donnell, D. D., Provost, ...	1	0	0						
Arthur R. Nugent, Esq., .	1	0	0						
John Purser, Esq., . . .	2	0	0						
Ven. Archdeacon Strong, .	1	0	0						
W. R. Wilde, Esq., . . .	1	0	0						
Received from Members of the Royal Irish Academy,				21	1	0			
Total Subscriptions for Gold Ornaments, ...							58	1	
Forward,							1207	14	

	£	s.	d.	£	s.	d.
Brought forward,				1207	14	1
CONTINGENCIES.						
J. L. Rickards, Postage, ...	0	4	6			
Royal Dublin Society, Carriage of Parcels, ...	0	6	6			
Total Contingencies, .				0	11	0
ANTIQUITIES.						
Magrath, Edward, purchase from, not confirmed by Committee of Antiquities, ...	. . . .			1	0	0
TOTAL AMOUNT OF CHARGE, .	. . . .			1209	5	1

THE DISCHARGE.

Antiquities.				£	s.	d.	£	s.
Archbold, C., stoneware jug, ...				2	0	0		
Bindon, S. H., silver fibula, ...				8	0	0		
Byrne, A., small cross, ...				0	1	0		
Conroy, Mary, sundries, ...				2	2	0		
Cumming, Rev. J. G., castings in plaster of stone crosses in Isle of Man, . . .				14	14	0		
Curry, Eugene, bronze hoop, ...				0	1	0		
Daly, Michael, sundries, ...				1	0	0		
Du Noyer, G. V., bronze trumpet, . . .				4	0	0		
Evans, John, private seal, ...				0	10	0		
Fegan, P., collection, ...				6	0	0		
Flood, A., sundries, ...				0	7	6		
Geraghty, M., spear and coin, ...				0	10	0		
Jones, J. F., silver fibula, ...				3	15	6		
Magrath, Edward, jack boots, ...				1	0	0		
Murray, Richard, collection, ...				83	0	0		
Todd, Rev. J. H., D.D., silver seal, &c., .				2	10	0		
Underwood, James, collection, ...				8	3	0		
Wakeman, W. F., on account of collection,				10	0	0		
Total Antiquities Purchased,							147	14
Books, Printing, and Stationery.								
Barthes and Lowel, books, . .	£5	5	0					
Bindon, H. S., books, . . .	1	0	0					
Caldwell, L., books, ...	0	10	0					
Carroll, B., books, ...	0	6	0					
Corry, J., map, ...	0	2	6					
Hodges and Smith, books to 30th December, 1854, . .	35	8	8					
Jones, J. F., books, ...	5	2	3					
Kelly, W. B., books, ...	0	10	0					
Mulligan, T., directory, . . .	0	12	6					
Ray Society, subscriptions, 1853 and 1854, ...	2	2	0					
Total Books Purchased for Library, ...				50	18	11		
Barthes and Lowel, charges on books presented to Library, ...				4	8	6		
Forward,				55	7	5	147	14

		£ s. d.	£ s. d.
Brought forward,		55 7 5	147 14 0
Gill, M. H., on account of printing Proceedings, vol. vi. part 1, ...	£17 0 0		
Johnson and Co., advertising Transactions, ...	3 18 0		
Oldham, W., wood engravings for ditto, ...	10 11 0		
O'Neill and Duggan, copper-plate engraving and printing for ditto, ...	19 3 0		
Total Printing Proceedings and Transactions,		50 12 0	
Gill, M. H., miscellaneous printing, ...		17 2 4	
Ferrier and Co., wrapping paper,	0 18 4		
Tallon, J., stationery, ...	5 5 3		
Waller, J., printing cards, .	1 2 0		
Warren, —, ink, ...	0 2 6		
Yeates, George, sundries, . .	1 18 9		
		9 6 10	
Total amount of Books, Stationery, &c.,			132 8 7
Repairs of House.			
Bray, John, cleaning ash-pit, ...		0 12 0	
Casey, Paul, iron pins, &c., ...		3 16 3	
Daniel, P., hooks, &c., ...		0 1 10	
Giblin, C. W., plastering, ...		0 15 0	
Murphy, James, sweeping chimneys, . .		1 7 0	
Pim and Co., ...		0 3 0	
Total Repairs of House, . . .			6 15 1
Taxes and Insurances.			
National Insurance Company,	£12 6 0		
Patriotic Insurance Company,	6 3 6		
		1 9 6	
Minister's money, ...		2 15 5	
Parish cess, ...		0 18 9	
Property tax, ...		4 9 9	
Pipe-water tax, ...		2 17 8	
Total Taxes and Insurance, . .			29 11 1
Furniture and Repairs.			
Andrews, W., carpeting, ...		142 12 6	
Angeli, L., cleaning busts, &c., ...		3 5 0	
Forward,		145 17 6	316 8 9

	£	s.	d.	£	s.	d.
Brought forward,	145	17	6	316	8	
Casey, Paul, repairing locks, &c., . . .	0	18	0			
Daniel, P., nails, &c., ...	1	16	4			
Edmundson, J., repairing lanterns, . .	0	14	1			
Feeley, M., chairs, ...	6	8	0			
Jones and Son, painting, ...	1	0	0			
Johnson, J., oil, &c., ...	0	4	4			
Mooney, W., gas fittings, ...	37	14	1			
O'Brien, M., repairing Library table, .	16	0	0			
Pike, W., truck, &c., ...	2	8	3			
Walpole, E., gray linen, ...	2	14	2			
Total Furniture and Repairs, .				215	14	9
Salaries, Wages, Etc.						
Ball, Robert, LL. D., Treasurer, . . .	21	0	0			
Drummond, Rev. W. H., D.D., Librarian,	21	0	0			
Jellett, Rev. J. H., Secretary of Council,	21	0	0			
Todd, Rev. J. H., D. D., Secretary of Academy, ...	42	0	0			
Clibborn, Edward, Clerk and Curator, .	150	0	0			
Todhunter, Isaac, Accountant, ...	51	0	0			
O'Brien, Thomas, library porter, . . .	39	15	0			
Leigh, Simon, hall porter, ...	33	2	6			
Johnstone, J., messenger, ...	7	4	0			
O'Neil, E., cleaning house, ...	3	12	0			
Fawcett, G., evening meetings, ...	0	10	0			
Total Salaries, Wages, &c., . .				390	3	6
Contingencies.						
Clibborn, E., allowance for sundries used in cleaning house, for the year 1854–55,	10	0	0			
Freights and charges on books, ...	15	9	6			
Postage stamps and postage, ...	8	14	0			
Petty charges and incidentals, ...	5	7	8			
Total Contingencies, ...				39	11	2
Coals, Gas, Etc.						
Alliance Gas Company, gas and coke, .	21	12	10			
Holmes, Thomas, 15 tons of coal, . . .	14	10	0			
Toole, Martin, 11 tons of coal, ...	11	0	0			
Kane, —, turf, ...	0	11	0			
Lambert, J., candles, ...	0	13	7			
Total amount of Coals, Gas, &c., .				48	7	
Forward,				1010	5	

	£ s. d.	£	s.	d.
Brought forward,		1010	5	7
BOARD OF PUBLIC WORKS.				
On account of rent of House, ...	. . . .	140	9	4
EXPENDITURE ON HOUSE, GRAFTON-STREET.				
Our proportion of arrears pipe-water tax,	. . . .	2	5	9
EXPENDITURE ON HOUSE, DAWSON-STREET.				
Clibborn, E., for cleaning house, from 10th Dec., 1853, to 16th Sept., 1854, . .	. . . .	21	0	0
Catalogue of Museum, ...	. . . .	0	4	9
Photographic apparatus, ...	. . . .	0	12	9
Subscription to gold ornaments, . . .	. . . .	1	16	10
Total Discharge, ...	. . . .	1176	15	0
Balance in favour of the Public,	. . . .	32	10	1
TOTAL AMOUNT OF CHARGE, . .	. . . .	1209	5	1

GENERAL ABSTRACT OF THE MONTHLY ACCOUNTS OF THE ROYAL IRISH ACADEMY,

AS FURNISHED TO AUDIT OFFICE, FROM 1st APRIL, 1854, TO 31st MARCH, 1855, INCLUSIVE.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance, 1st April, 1854,	52	0	5	By Antiquities,	147	14	0
To Government Grant and Treasury Allowance,	475	14	7	By Books, Printing, &c.,	182	8	7
To Interest on Stock,	90	6	5	By Taxes and Insurance,	29	11	1
To Transactions and Proceedings sold,	1	6	8	By Repairs of House,	6	15	1
To Life Compositions,	70	7	0	By Furniture and Repairs,	215	14	9
To Entrance Fees,	52	10	0	By Salaries, Wages, &c.,	390	3	6
To Annual Subscriptions,	407	8	0	By Contingencies,	39	11	2
To Antiquities,	1	0	0	By Coals, Gas, &c.,	48	7	5
To Subscriptions to Gold Ornaments,	58	1	0	By Board of Public Works,	140	9	4
To Contingencies,	0	11	0	By Catalogue of Museum,	0	4	9
				By Photographic Apparatus,	0	12	9
				By House, Grafton-street,	2	5	9
				By House, Dawson-street,	21	0	0
				By Subscriptions to Gold Ornaments,	1	16	10
					1176	15	0
				By Balance indebted 31st March, 1855,	32	10	1
	1209	5	1		1209	5	1

The Treasurer reports, that there is to the credit of the Academy, in the Bank of Ireland, £1229 14*s.* 5*d.* in 3 per cent. Consols, and £1643 19*s.* 6*d.* in 3 per cent. Government Stock, the latter known as the Conyngham Fund.

31*st March*, 1855.

(Signed), ROBERT BALL,
Treasurer.

No. III.

CATALOGUE OF BOOKS

THE PROPERTY OF

THE LATE THOMAS MOORE, ESQ.,

PRESENTED TO

The Royal Irish Academy

BY MRS. THOMAS MOORE.

(AUGUST 28TH, 1855.)

613 Abd-Allatif, Relation de l'Egypte. Traduit avec notes, par Silvestre de Sacy. 4°. *Paris*, 1810

746 Abul-feda (Ismael), de Vita Mohammedis, notis Gagnier. folio. *Oxon.* 1723

607 Acta Eruditorum. 4°. 1685, 1690, 1692 to 1694, 1697, 1698, 1702, 1704, 1706 to 1709, 1711, 1712, 1715, 1717 to 1720, 1725, 1726, and Index to 1714.

249 Adair's (Rt. Hon. Sir R.) Mission to the Court of Vienna in 1806. 8°. *Lond.* 1844

222 Adam (Rev. Robt.), Religious World. 12°. *Lond.* 1824

664 Adolphe. 12°. *Paris*, 1824

108 Adolphus' (Jno.) History of England under Geo. III. 8°. 3 vols. *Lond.* 1810

30 Adventurer (The). 4 vols. 12°. *Lond.* 1778

485 Æliani de Animalium natura lib. Gr. et Lat. Gillio et Gesnero interp. 16°. 1611

694 Aihcrappih; Histoire Grecque. 12°. *n. d.*

612 Ainsworth's (R.) Latin Dictionary, by Morell. 4°. *Lond.* 1808

468 Albertus Magnus de Secretis Mulierum, &c. 16°. *Amst.* 1655

492 Alciphronis Epistolæ. Gr. et Lat. 12°. *Traj. ad Rh.* 1791

498 —— Epistolæ, Gr. et Lat., notis illust. S. Bergher. 8°. *Lipsiæ*, 1715

565 Alfieri (V.), Vita di, scritta da esso. 12°. *Italia*, 1817
566 —— Tragedie di, 4 tom. 12°. *Pisa*, 1818
816 —— sa vie écrite par lui-même. 8°. 2 tomes. *Paris*, 1809
643 Almanach des Gourmands. 16°. 8 tomes. *Paris*, 1810–12
641 Amours de Tibulle. 16°. 3 tomes. *Amst.* 1715
487 Anacreontis Carmina. Gr. et Lat. 12°. *Parma*, 1791
516 —— Odæ. Gr. et Lat. 12°. *Dub.* 1801
495 —— Sappho et Alcæus. Gr. et. Lat. 12°. *Glasg.* 1777
795 Anacréon, Odes d'; traduites en Francois avec le texte Grec, la version Latine, des notes, etc., par Gail. 4°. *Paris*, 1799
604 Anacreonte, tradotto in versi Italiani da varj. 4°. *Venezia*, 1736
523 Analecta, sive Collectanea Græca Majora, cum notis A. Dalzel. 8°. 2 vols. *Lond.* 1830
660 Ana: Carpentariana. 12°. *Paris*, 1724
692 —— Chevræana. 12°. *Amst.* 1700
652 —— Chevræana. 12°. (Duplicate.) *Amst.* 1700
653 —— Ducatiana. 12°. 2 tomes. *Amst.* 1738
673 —— Longueruana. 12°. *Berlin*, 1754
655 —— Naudæana et Patiniana. 12°. *Amst.* 1703
654 —— Parrhasiana. 12°. 2 tomes. *Amst.* 1701
675 —— Poggiana. 12°. 2 tomes. *Amst.* 1720
659 —— Santoliana. 12°. *Paris*, 1764
687 —— Valesiana. 12°. *Paris*, 1695
52 Ancient Irish Histories, the Works of Spenser, Campion, Hanmer, and Marlburrough. 8°. 2 vols. *Dub.* 1809
97 Anecdotes of the Life of Pitt, Earl of Chatham. 8°. 3 vols. *Lond.* 1810
580 —— du 18me Siècle. 12°. Tom. 1. *Lond.* 1783
166 Anderson's (Æneas) Journal of the Expedition to Egypt under Sir R. Abercromby. 4°. *Lond.* 1802
449 Annals of the Kingdom of Ireland by the Four Masters, with Notes by J. O'Donovan. 4°. 3 vols. *Dub.* 1848
785 Annual Register (Dodsley's). 8°. Vol. 1 to 59, and Index. *Lond.* 1758–1817
700 Anquetil, Precis de l'Histoire Universelle. 12°. 12 tomes. *Paris*, 1801
194 Answer to Fontenelle's History of Oracles. 8°. *Lond.* 1709

480 Anthologia; seu selecta quædam Poemata Italorum. 12°. *Lond.* 1684
176 Anti-Union (The). 4°. *Dub.* 1798
486 Aphthonii Sophistæ Progymnasmata, F. Scobario interp. Gr. et Lat. 16°. *Paris,* 1623
685 Apulée, les Métamorphoses, ou L'Ane d'Or, trad. en Franç. 12°. 2 tomes. *Paris,* 1770
6 Ariosto, Orlando Furioso, emendato da Boschini. 24°. 6 tom. *Lond.* 1813
496 Aristæneti Epistolæ. Gr. et Lat. Notis Merceri. 12°. *Traj. ad Rh.* 1737
463 Aristophanis Comœdiæ. Gr. et Lat. Emend. Scaligeri. 16°. *Amst.* 1670
470 —— Comœdiæ. Gr. et. Lat. 16°. 2 vols. *Amst.* 1670
60 Armata, a Fragment. 8°. *Lond.* 1817
679 Arretin Moderne. 12°. Tom. 1. *Rome,* 1776
74 Asiatic Researches, or Transactions of the Bengal Society 11 vols. 8°. *Lond.* 1806–12
186 Atkins' (H. M.) Ascent to the Summit of Mont Blanc. 8°. *Lond.* 1838
574 Augustini lib. de Civitate Dei. 8°. Tom 2. *Genevæ,* 1622
479 Auli Gellii Noctes Atticæ. 12°. *Francof.* 1603
483 Ausonii Opera, Tollii. 16°. *Amst.* 1669

163 Bacon's (Lord), Severall Works hitherto sleeping, by W. Rawley. folio. *Lond.* 1657
66 —— Essays, with his Life. 8°. *Chisw.* 1812
743 Baillet (A.), Jugemens des Savans, &c. 8°. 13 vols. *Amst.* 1725
347 Baines' (Rt. Rev. P. A.) Defence of the Christian Religion. 8°. *Lond.* 1825
632 Balzac, ses Œuvres Diverses. 16°. 10 tomes. *Paris,* 1663
424 Baratariana: or, Select Fugitive Pieces. 12°. (2 copies.) *Dub.* 1772
791 Barbeyrac (J.), Traité de la Morale des Pères de l'Eglise. 4°. *Amst.* 1728
616 Baretti's (G.) Italian and English Dictionary. 4°. 2 vols. *Lond.* 1798
196 Barker's (E. H.) Letters on the Letters of Junius. 8°. *Lond.* 1828

de Vida et Despréaux, a

195 Battersby's (W. J.) Repea
788 Bayle (Pierre), Dictionna
4 tomes.
789 —— Œuvres Diverses. f
307 Beamish's (N. L.) Discover
the 10th century. 8°.
9 Beattie's (Jas.) Theory of I
126 Beaumont and Fletcher's W
14 vols.
391 Beccaria's (Marq.) Essay o
Commentary by Voltaire
706 Beckford (W.), Vathek. 8
183 Belfegor, a Poem. 8°.
368 Bell's (John) Dictionary of
530 Bentham's (Edw.) Funeral
Greek, with Extracts fro
4 Bentley's (Dr.) Dissertatio
the Fables of Æsop, exa

635 Béranger (M. J. P. de), ses Ch
388 Bergerac's (C.) Comical His
the Worlds of the Moon an

304 Betham's (Sir W.) Gael and Cimbri. 8°. *Dub.* 1834
306 —— Origin and History of the Constitution of England, and of the early Parliaments of Ireland. 8°. *Dub.* 1834
773 Bibliographie Musicale de la France et de l'Etranger. 8°. *Paris*, 1822
640 Bibliotheque Universelle et Historique (Le Clerc). 16°. 8 tom. *Amst.* 1686–89
273 Biographical Dictionary (a New and General). 8°. 15 vols. *Lond.* 1798
787 Biographie Nouvelle des Contemporains. 8°. 20 tomes. *Paris*, 1820–25
8 Blackwell's Letters concerning Mythology. 8°. *Lond.* 1748
5 Bland's (Rev. Robert) Collections from the Greek Anthology. 8°. *Lond.* 1813
262 —— Greek Anthology, with additions by Merivale. 8°. *Lond.* 1833
305 Blessington (Earl of), On the state of Ireland. 8°. *Lond.* 1822
151 Blount's (Sir T. P.) Remarks on Poetry. 4°. *Lond.* 1694
599 Boccaccio, Il Decamerone, da Ugo Foscolo. 8°. 3 tom. *Lond.* 1825
5 —— Decamerone, con note. 24°. 8 tom. *Parma*, 1814
683 Boileau-Despréaux, ses Œuvres, avec des Remarques par Saint-Marc. 12°. 5 tomes. *Amst.* 1772
286 Bonnycastle's (John) Astronomy. 8°. *Lond.* 1816
769 Bonstetten (C. V. de), Voyage dans le Latium. 8°. *Geneve*, 1805
269 Booth's (Abraham) Pedobaptism Examined. 8°. 3 vols. *Lond.* 1829
776 Bossuet (J. B.), Histoire des Variations des Eglises Protestantes. 8°. 4 tom. *Versailles*, 1817
741 —— ses Oraisons Funèbres. 12°. *Paris*, 1802
32 Bounden's (Joseph) Poems. 8°. *Lond.* 1824
239 Bowles' (Rev. W. L.) Lessons on Criticism. 8°. *Lond.* 1826
378 Bowring's (John) Specimens of the Russian Poets, translated. 12°. *Lond.* 1821
131 Boyd's (H. S.) Select Passages from St. Chrysostom, St. Gregory Nazianzen, and St. Basil. 8°. *Lond.* 1813
796 Boyer (A.), Dictionnaire François-Anglois. 4°. *Lyon*, 1792

150 —— (Thos.) Enquiries int

406 Bruce's Invasion of Irelan

50 —— (James) Travels to th

534 Brunck (R. F. P.), Analec
8°. 3 vols.

753 Bryan's (Michael) Diction
Parts 6, 7.

405 Brydges' (Sir E.) Bertram,

135 Burder's (Samuel) Oriental

268 Burghersh's (Lord) Memoi
Duke of Wellington in Pc

363 Burke's (Rt. Hon. Edm.) Sp

93 —— Reflections on the Fre

288 Burke's (J. H.) Days in the

521 Burneius (C.), Tentamen d

431 Burnet's (Thos.) Sacred The

543 —— Telluris Theoria Sacra

193 —— Archæologia Philosoph

26 Butler's (Charles) Lives of

167 Camden Society Publications, 4°. 44 vols. *Lond.* 1840–49
589 Camoes Poema. 12°. *Paris*, 1825
94 Campbell's (J.) Philosophical Survey of the South of Ireland. 8°. *Lond.* 1777
263 —— Philosophical Survey of the South of Ireland. 8°. *Dub.* 1778
407 Cant, a Satire. 12°. *Lond.* 1843
170 Carlyle's (J. D.) Specimens of Arabian Poetry. 4°. *Camb.* 1796
775 Carmontelle ses Proverbes Dramatiques avec addit. par De Mery. 8°. 4 tomes. *Paris*, 1822
390 Carpenter's (J. E.), Romance of the Dreamer, and other Poems. 12°. *Lond.* 1841
586 Casti (G.), Novelle Galanti. 12°. 2 tom. *Milano*, 1802
460 Catalogue of the Harleian Manuscripts in the British Museum. folio. 4 vols. *Lond.* 1808–12
185 —— of the Loganian Library. 8°. *Philad.* 1792
213 Catholic (The) Annual. 8°. *Lond.* 1830
386 Catullus, translated by the Hon. Geo. Lamb. 12°. 2 vols. *Lond.* 1821
488 Catulli, Tibulli, et Propertii Opera. 12°. *Lond.* 1715
497 —— Tibulli et Propertii Opera. 12°. *Lond.* 1776
477 —— Carmina, edidit J. A. Amar. 32°. *Paris*, 1821
328 Causes (The) of the French Revolution. 8°. *Lond.* 1832
618 Chambaud's (Louis) French and English Dictionary. 4°. 2 vols. *Lond.* 1805
721 Chansonnier de l'Amour. 16°. *n. d.*
779 Chants Populaires de la Grèce Moderne, avec une traduct. et des notes par Fauriel. 8°. *Paris*, 1824
197 Characteristics of Goethe, with notes; translated by S. Austin. 8°. 3 vols. *Lond.* 1833
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617 Tiraboschi (G.), Storia della Letteratura Italiana. 4°. 10 tom. in 13. *Roma*, 1797

282 Tomb's (J. W.) Pneumatogony, a Poem. 8°. *Lond.* 1845

133 Tooti Nameh (The), or, Tales of a Parrot, in Persian and English. 8°. *Lond.* 1801

467 Tragœdiæ Selectæ Æschyli, Sophoclis, Euripidis, cum duplici interpret. Latina. 16°. 1567

12 Transactions of the Gaelic Society of Dublin. 8°. Vol. 1. *Dub.* 1808

344 Treatise on the Progress of Literature, and its Effects on Society. 8°. *Edinb.* 1834

339 Trevern's (Right Rev. J. T. M.) Amicable Discussion on the Church of England. 8°. 2 vols. *Lond.* 1828

376 —— Answer to Faber's Difficulties of Romanism, translated by Husenbeth. 8°. (2 copies.) *Lond.* 1828

117 Trial of Warren Hastings. 8°. *Lond.* 1796

256 Tribute (The), or, Unpublished Poems by various Authors; edited by Lord Northampton. 8°. *Lond.* 1837

82 Tryphiodorus' Sequel to the Iliad, in Greek, with Translation and Notes by Merrick. 8°. *Oxf.* 1739

226 Turnbull's (Mrs.) Song of Azrael, and other Poems. 12°. *Lond.* 1840

542 Van Dale (Ant.), De Origine ac Progressu Idolatriæ et Superstitionum. 4°. *Amst.* 1696
594 Vasari (G.), Vite de, Pittori, Scultori e Architetti. 8°. 6 tom. *Milano*, 1811
593 Vasi, Itinerario di Roma. 12°. 2 tom. *Roma*, 1818
527 Villanueva (J. L.), Ibernia Phœnicea. 8°. *Dub.* 1831
811 —— Phœnician Ireland; translated, with Notes by H. O'Brien. 8°. *Lond.* 1833
598 —— Poesias Escogidas. 12°. (2 copies.) *Dub.* 1833
813 Villers (Chas.), Essai sur l'Esprit et l'Influence de la Réformation de Luther. 8°. *Paris*, 1808
294 Vindiciæ Hibernicæ; an Historical Argument to prove Ireland not a conquered country. 8°. *Lond.* 1838
719 Vingt-quatre Heures d'une Femme sensible, ou une grande leçon. 8°. *Paris*, 1824
531 Virgilii Opera, adnotatione a Heyne. 8°. 4 vols. *Lond.* 1793
482 —— Opera, not perfect. 16°.
129 —— translated by John Ring. 8°. 2 vols. *Lond.* 1820
300 —— Georgics; translated by Sotheby. 8°. *Lond.* 1800
782 Voltaire, ses Œuvres Complètes. 8°. 72 tomes. *Basle*, 1784–1801
780 —— La Pucelle d'Orléans. 8°. *Lond.* 1761
623 —— La Pucelle d'Orléans. 32°. *Lond.* 1790
797 —— La Henriade, &c. 4°. *Geneve*, 1768
639 —— Romans. 16°. Tom. 3. *Paris*, 1816
533 Vossii (G. J.) de Historicis Græcis lib. 4°. *Lugd. Bat.* 1624
545 —— de Theologia Gentili et Physiologia Christiana lib. 4°. *Amst.* 1641
621 Voyages d'Antenor en Grèce et en Asie, avec des notions sur l'Egypte. 16°. 5 tomes. *Paris*, 1804
626 Voyages de la Perse dans l'Inde, et du Bengal en Perse. 16°. 2 tomes. *Paris*, 1798

201 Wade's (Thomas) Poems and Sonnets. 8°. *Lond.* 1835
429 Walker's (J. C.) Memoirs of the Irish Bards, &c. 4°. *Lond.* 1786
410 Wallenstein's Camp, from the German; and Original Poems (by Lord F. L. Gower). 12°. *Lond.* 1830
297 Wall's (W. E.) Christ Crucified; a Poem. 8°. *Oxf.* 1833

6 Walpole's (H.) Catalogue of the Royal and Noble Authors of England. 8°. *Edin.* 1796
442 Walpole's (Robt.) Memoirs of Turkey. 4°. *Lond.* 1817
257 War in Disguise; or, the Frauds of the Neutral Flags. 8°. *Lond.* 1806
11 Waterland's (D.) Review of the Doctrine of the Eucharist. 8°. *Lond.* 1737
33 Watts' (Isaac) Logic. 12°. *Lond.* 1793
301 Weatherhead's (G. H.) Pedestrian Tour through France and Italy. 8°. *Lond.* 1834
16 Webb's (W.) Analysis of the History and Antiquities of Ireland. 8°. *Dub.* 1791
54 Wheatley's Review of Knight and Price on the Picturesque. 8°. *Lond.* 1795
411 White's (E. H.) Athelstan, a Tragedy. 12°. *Lond.* 1847
379 Wiffen's (J. H.) Julia Alpinula; and other Poems. 12°. *Lond.* 1820
102 Williams' (H. W.) Travels in Greece, Italy, and the Ionian Islands. 8°. 2 vols. *Edinb.* 1820
48 Wilson's (Rev. T.) Archæological Dictionary. 8°. *Lond.* 1783
614 Winkelmann, Histoire de l'Art chez les Anciens, traduit avec des Notes. 4°. 2 tom. *Paris,* 1802
142 Works of the English Poets, edited by Dr. Johnson, with additional Lives by Alex. Chalmers. 8°. 21 vols. *Lond.* 1810
200 Wright's (Frances) Few Days in Athens. 8°. *Lond.* 1822
242 Wyse's (Thos.) Historical Sketch of the Catholic Association 8°. 2 vols. *Lond.* 1829

107 Young's (A.) Travels in France. 8°. 2 vols. *Dub.* 1793

502 Zosimi Historia. Gr. et Lat. Notis var. cur. Cellario. 8°. *Jenæ,* 1729

See "PROCEEDINGS," vol. VI. p. 261.

No. IV.

ACCOUNT
OF
THE ROYAL IRISH ACADEMY,

FROM 1ST APRIL, 1855, TO 31ST MARCH, 1856.

THE CHARGE.

	£	s.	d.	£	s.	d.
To Balance in favour of the Public on 1st April, 1855 (see Ap. No. II., p. xvii.), .	.	. .	.	32	10	1
Parliamentary Grant, ...	300	0	0			
———————— towards Library, .	100	0	0			
———————— towards Museum, .	100	0	0			
———————— towards purchase of Gold Ornaments found in Co. Clare, .	150	0	0			
Quarterly Warrants from Treasury, . .	34	11	7			
Total from Government, .				684	11	7
Interest on Stocks:						
Half year's on £1643 19 6 at 3½ ℔ Cent.	24	13	2			
One year's on £1229 14 5 at 3 " .	36	17	10			
Half year's on £1143 19 6 " " .	17	3	2			
Total Interest on Stocks, .				78	14	2
Stock Sold:						
£500 3 ℔ Cents. sold, ...	.	. .	.	464	19	5
Transactions and Proceedings sold:						
T. and W. Boone, ...	14	6	0			
J. Purser, ...	0	2	6			
				14	8	6
Life Compositions:						
T. E. Beatty, M. D., ...	6	6	0			
Cheyne Brady, Esq., ...	18	18	0			
Richard G. Butcher, Esq., ...	21	0	0			
Samuel Ferguson, Esq., ...	6	6	0			
J. T. Gilbert, Esq., ...	21	0	0			
Edward Hutton, M. D., ...	6	6	0			
Rev. J. B. Sayers, LL. D., ...	15	15	0			
Edward Senior, Esq., ...	21	0	0			
Aquilla Smith, M. D., ...	6	6	0			
William Stokes, M. D., ...	6	6	0			
J. E. Walsh, LL. D., ...	21	0	0			
Edward Wright, LL. D., ...	21	0	0			
Total Life Compositions, .				171	3	0
Forward,	.	. .	.	1446	6	9

	£	s.	d.
Brought forward,	1446	6	9
Entrance Fees (£5 5s. each):—Edmund W. Davy, M. B.; Samuel Downing, LL. D.; J. T. Gilbert, Esq.; John Ringland, M. B.; J. E. Walsh, LL. D.; James West, Esq.; Edward Wright, LL. D.			
Total Entrance Fees, .	36	15	0

Annual Subscriptions (£2 2s. each).

For 1853:—R. V. Boyle. (£2 2s.)

For 1854:—
Signor Angeli; A. W. Baker; T. J. Beasly; T. E. Beatty, M. D.; Sir R. G. Booth, Bart.; R. V. Boyle; F. W. Burton; A. B. Cane; Sir P. Crampton, Bart.; C. F. Fortescue; E. Getty; G. A. Hamilton; W. N. Irwin; Rev. R. J. M'Ghee; A. G. Melville, M. D.; Right Hon. W. Monsell; W. J. O'Driscoll; Right Hon. D. R. Pigot; Robert Tighe. (£39 18s.)

For 1855:—
Rev. I. G. Abeltshauser; R. Adams, M. D.; Rev. J. Alcorn; J. Aldridge, M. D.; W. Andrews; J. Anster, LL. D.; W. Armstrong; A. W. Baker; W. Barker, M. B.; W. O. Barker, M. D.; E. Barnes; H. C. Beauchamp, M. D.; J. Bell; P. Bevan, M. D.; E. Bewley, M. D.; Sir R. G. Booth, Bart.; D. F. Brady, M. D.; D. Brereton, M. D.; F. W. Burton; A. B. Cane; H. Carlile, M. D.; S. Carter; T. Cather; Sir B. I. Chapman, Bart.; H. Clare; F. Clarendon; J. Claridge; E. S. Clarke, M. D.; F. Codd; A. Cooke; Sir P. Crampton, Bart.; E. Curry; W. Dargan; J. Davidson; M. P. D'Arcy; R. Deasy; Viscount Dungannon; J. C. Egan, M. D.; Earl of Enniskillen; A. Ferrier; J. Finlay, LL. D.; Lord W. Fitzgerald; G. Fitzgibbon; C. Fleming, M. D.; L. E. Foot; C. S. Fortescue; Captain G. A. Frazer; H. Freke, M. D.; Rev. J. A. Galbraith; E. Getty; S. Gordon, M. D.; Very Rev. Dean of Kildare; D. Griffin, M. D.; W. Grimshaw; T. Grubb; C. W. Hamilton; G. A. Hamilton; W. N. Hancock, LL. D.; W. H. Hardinge; Rev. S. Haughton; E. Hutton, M. D.; J. K. Ingram, LL. D.; W. N. Irwin; Lieut.-Col. James; Sir J. K. James, Bart.; Rev. J. H. Jellett; F. M. Jennings; P. Jones; H. H. Joy; T. F. Kelly, LL. D.; G. A. Kennedy, M. D.; H. Kennedy, M. D.; W. T. Kent; Lord Bishop of Kilmore; R. Law, M. D.; A. Leared,

	£	s.	d.
Forward,	1483	1	9

	£	s.	d.
Brought forward,	1483	1	9

M. B.; Rev. A. Leeper; F. L'Estrange; W. R. Le Fanu; G. Lefroy; J. Lentaigne, M. D.; W. T. Lloyd; Rev. G. Longfield; M. Longfield, LL. D.; W. Longfield; R. D. Lyons, M. B.; A. H. M'Clintock, M. D.; J. S. Macdonnell; W. MacDougall; Rev. R. J. M'Ghee; R. R. Madden, M. D.; J. Magee; Rev. E. Marks, D. D.; G. M. Miller; Right Hon. W. Monsell; D. Moore; J. M. Neligan, M. D.; J. O'Donovan, LL. D; W. J. O'Driscoll; J. R. O'Flanagan; M. M. O'Grady, M. D.; J. Osborne, M. D.; J. Patten, M. D.; Right Hon. Chief Baron Pigot; J. E. Pigot; J. B. Pratt; G. Roe; G. Sanders; Rev. J. B. Sayers; O'N. Segrave; F. J. Sidney, LL. D.; A. Smyth, M. D.; C. Smith; R. W. Smith, M. D.; H. Smith; Sir T. Staples, Bart.; M. H. Stapleton, M. B.; D. P. Starkey; H. H. Stewart, M. D.; W. Stokes, M. D.; R. Tighe; T. J. Tufnell; J. F. Waller, LL. D.; R. C. Williams, M. D.; Rev. J. Wills, D. D.; Right Hon. J. Wynne; G. Yeates. (£266 14*s.*)

For 1856:—

J. Aldridge, M. D.; W. O. Barker, M. D.; J. Bell; Right Hon. F. Blackburne, LL. D.; Sir J. B. Burke; J. Burrowes; Very Rev. R. Butler; A. Carte, M. B.; T. Cather; Sir B. I. Chapman, Bart.; F. Churchill, M. D.; E. W. Davy, A. B.; M. P. Darcy; Viscount De Vesci; C. Domvile; M. Donovan; C. Doyne; Earl of Enniskillen; Baron Farnham; A. Ferrier; Ven. W. Fitzgerald, D. D.; G. Fitzgibbon; L. E. Foot; W. Henn; W. Hogan; Lieut.-Col. James; J. C. F. Kenny; Lord Bishop of Kilmore; C. C. King, M. D.; F. L'Estrange; G. Lefroy; M. Longfield, LL. D.; W. Mac Dougall; A. J. Maley; Rev. E. Marks, D. D.; Right Hon. W. Monsell; C. Moore; Rev. O. W. Moore; A. R. Nugent; J. O'Donovan, LL. D.; J. Owen; Hon. and Very Rev. H. Pakenham; J. Ringland, M. B.; G. Roe, D. L.; C. Smith; Lord Talbot de Malahide; T. J. Tufnell; C. Vignoles; Ven. John West, D. D. (£102 18*s.*)

	£	s.	d.
Total Annual Subscriptions, .	411	12	0
Forward,	1894	13	9

				£	s.	d.	£	s.	d.
Brought forward,				. . . .			1894	13	9
SUBSCRIPTIONS TOWARDS THE PURCHASE OF GOLD ORNAMENTS FOUND IN CO. CLARE.									
Anon., per Rev. Dr. Todd,	£1	0	0						
Rt. Hon. Sidney Herbert, .	10	0	0						
M. H. Gill, Esq., ...	1	0	0						
Rev. James Graves, . . .	0	10	0						
Rev. Dr. Wilson (Cambridge),	5	0	0						
Received from Subscribers not Members of the Academy, ...				17	10	0			
James Apjohn, M. D., . .	1	0	0						
Rt. Hon. F. Blackburne, .	5	0	0						
Rev. Samuel Butcher, D. D.,	1	0	0						
Rt. Hon. Lord Chancellor,	5	0	0						
J. R. T. Colclough, Esq. .	5	0	0						
Charles Hanlon, Esq., . .	1	0	0						
Rev. Samuel Haughton, .	1	0	0						
J. K. Ingram, LL. D., . .	1	0	0						
Rev. J. H. Jellett, A. M., .	5	0	0						
Marquis of Kildare, . . .	5	0	0						
Colonel T. A. Larcom, . .	5	0	0						
Rev. H. Lloyd, D. D., . .	5	0	0						
Rev. George Longfield, . .	1	0	0						
Rev. Thomas M'Neece, D.D.,	1	0	0						
Lord Talbot de Malahide, .	5	0	0						
Rev. J. H. Porter, D. D., .	1	0	0						
Rev. T. R. Robinson, D. D.,	5	0	0						
Aquilla Smith, M. D., . .	1	0	0						
Rev. J. H. Todd, D. D., .	5	0	0						
Rev. C. W. Wall, D. D., .	1	0	0						
Received from Members of the Royal Irish Academy,				60	0	0			
Total Subscriptions for Gold Ornaments, ...							77	10	0
PHOTOGRAPHIC APPARATUS.									
E. K. Tenison, Esq., ...				. . . . .			2	15	0
FURNITURE.									
J. F. Waller, LL. D., ...				. . . . .			0	2	6
CONTINGENCIES.									
Sir W. R. Hamilton, LL. D., ...				. . . . .			0	5	[illegible]
TOTAL AMOUNT OF CHARGE, .				. . . . .			1975	6	[illegible]

THE DISCHARGE.

Antiquities Purchased, Etc.	£	s.	d.	£	s.	d.
Barker, J. M. B., coins, 11th June, 1855,	0	10	0			
Clary, M., capital of a pillar, 1st May, 1855, ...	0	3	6			
Conroy, Mary, antiquities, May 2, 1855, .	0	1	0			
Donegan, John, bronze celt, April 5, 1855,	1	0	0			
———— gold ornament, August 15, 1855, ...	1	10	0			
Todd, Rev., J. H., D. D., gold plates, 10th March, 1856, ...	4	0	0			
Underwood, J. H., antiquities, September 1, 1855, ...	4	0	0			
———— dagger and fibula, 11th September, 1855, ...	0	10	0			
Wakeman, W. F., antiquities, 25th May, 1855, ...	30	0	0			
———— antiquities, 28th June, 1855, ...	13	0	0			
———— antiquities, 17th July, 1855, ...	10	0	0			
———— antiquities, 18th September, 1855, ...	7	0	0			
West, James, on acct. of gold ornaments found in Co. Clare, 17th March, 1856, .	300	0	0			
Williams, James, sword and dagger, November 6, 1855, ...	0	17	6			
Total Amount of Antiquities,				372	12	0

Books, Printing, and Stationery.

	£	s.	d.		£	s.	d.
Barthes and Lowell, books, 27th November, 1855, . . .	£2	1	0				
Boone, T. and J., books, 31st December, 1855, ...	6	19	9				
Carroll, B., books, 31st March, 1856, ...	8	1	0				
Fleming, T. F., books, 10th December, 1855, ...	0	3	0				
Hodges and Smith, books, 5th February, 1856, ...	31	8	8				
Jones, J. T., books, 30th June, 1855, ...	2	15	0				
Leigh, S., book, 12th March, 1856, ...	0	1	0				
Forward, . .	£51	9	5	. . . . .	372	12	0

				£	s.	d.	£	s.	d.
Brought forward,				.	.	.	372	12	0
Brought forward, ...	£51	9	5						
Lewes, H., books, 16th June, 1855, ...	1	8	3						
Magrane, W., books, 24th March, 1856, ...	3	5	6						
O'Daly, John, books, 26th May, 1855, ...	1	2	6						
Vance, F., books, January 7th, 1856, ...	0	13	6						
Total Books Bought,				57	19	2			
Pilkington, F., binding books, January 18, 1856, ...				100	1	0			
Gill, M. H., miscellaneous printing, 16th June, 1855,	22	18	10						
——— ditto, 29th March, 1856, ...	16	12	9						
——— printing vol. xxii. part 5, Transactions, 16th June, 1855, ...	191	2	2						
——— ditto vol. xxii. part 6, 19th January, 1856,	56	17	10						
——— printing vol. vi. part 1, Proceedings, 12th May, 1855, ...	27	14	6						
——— ditto vol. vi. part 2, 19th January, 1856,	59	18	4						
Total Printing, .				375	4	5			
Oldham, William, wood engraving, March, 1856, ...				11	5	0			
Pilkington, F., binding Transactions and Procedings, January 10th, 1856, . .				35	19	6			
Ferrier and Co., wrapping-paper, 23rd May, 1855, .	2	7	6						
Hendrick, R., Stationery, 25th August, 1855, ...	1	15	0						
Rathborne and Co., wax, wafers, 27th June, 1855, . . .	0	2	6						
Tallon, J., stationery, 31st January, 1856, ...	6	7	9						
Tighe, J., diplomas, 4th June, 1855, ...	1	18	6						
Waller, J., cards, January 31, 1856, ...	0	11	0						
Total Stationery, .				13	2	3			
Forward,				593	11	4	372	12	0

	£	s.	d.	£	s.	d.
Brought forward,	593	11	4	372	12	0
Steam-packet Co., freight of Mr. Moore's Library, 3rd September, 1855, . . .	8	15	4			
Total amount of Books, Printing, and Stationery, ...				602	6	8
Taxes and Insurance, Etc.						
Boyle, Low, and Co., Income tax on dividends to January 1, 1856, ...	5	0	10			
National Insurance Co., Dec. 24, 1855, .	12	16	0			
Patriotic Insurance Co., to Dec. 24, 1855,	6	3	6			
Parish Cess for 1855, ...	0	6	3			
Pipe-water tax for 1855, ...	2	17	8			
Total Taxes and Insurances, .				27	4	3
Repairs of House.						
Alliance Gas Company, May 29, 1855, .	0	3	6			
Austin, R., cleaning windows, March 15, 1856, ...	1	13	5			
Bray, John, cleaning ash-pit, February 23, 1856, ...	0	12	0			
Murphy, J., sweeping chimneys, March 14, 1856, ...	1	1	0			
Sibthorpe, H., and Son, glazing, &c., June 28, 1855, ...	11	4	0			
Daniel, P., nails, &c., Feb. 4, 1856, . .	1	2	0			
Total Repairs of House, .				15	15	11
Furniture and Repairs.						
Andrews, W., carpets, &c., March 22, 1856,	56	13	7			
Angeli, L., painting crosses, &c., April 7, 1855, ...	1	15	0			
Casey, P., pins for Library, Dec. 29, 1855,	0	13	0			
Daniel, P., twine boxes, &c., April 6, 1855,	0	19	2			
Dobbyn, J., repairing clock, Feb. 8, 1855,	0	10	6			
Elvery and Co., spring porters, March 12, 1856, ...	0	5	0			
Feely, L., chairs, June 30, 1855, . . .	6	3	6			
Fry, W., and Co., table cover, fringe, &c., August 25, 1855, ...	2	9	4			
Fehan, John, mop, September, 18, 1855, .	0	2	0			
Johnson, J., japan, varnish, &c., Dec. 31, 1855, ...	0	12	7			
Forward,	70	3	8	1017	18	10

	£	s.	d.	£	s.	d.
Brought forward,	70	3	8	1017	18	10
Jones, J. T., two royal coats of arms, Feb. 22, 1856, ...	0	8	0			
Kelly, J., cleaning carpets, Oct. 22, 1855,	1	0	0			
Kerr and Co., chairs, &c., March 22, 1856,	47	3	6			
Mooney, W., gas fittings, &c., Aug. 11, 1855, ...	14	7	6			
Pike, W. H., japanned boxes, &c., June 11, 1855, ...	4	4	6			
Walpole, E., towels, &c., Jan. 1, 1856, .	1	9	10			
West, T., glass urns, March 15, 1856, .	0	12	6			
Total Furniture and Repairs, .				139	9	6
Salaries, Wages, Etc.						
Ball, Robert, LL. D., Treasurer, . . .	21	0	0			
Drummond, Rev. W. H., D. D., Librarian,	21	0	0			
Jellett, Rev. J. H., Secretary of Council,	21	0	0			
Todd, Rev. J. H., D.D., Secretary of Academy, ...	21	0	0			
Clibborn, Edward, Clerk and Curator, .	150	0	0			
Todhunter, Isaac, Accountant, ...	50	0	0			
O'Brien, Thomas, porter, ...	13	10	0			
Leigh, Simon, porter, ...	36	12	6			
Johnstone, James, messenger, ...	5	14	0			
Flinn, J., porter, ...	30	15	0			
O'Neill, E., for cleaning house, ...	7	18	9			
Faucett, G., for attendance at evening meetings, ...	1	11	6			
Liveries, working jackets, &c., for porters,	21	13	11			
Total Salaries, Wages, &c., .				401	15	8
Contingencies.						
Clibborn, E., allowance for sundries used in cleaning house, for the year 1855–56,	10	0	0			
Freight and charges on parcels, ...	13	14	6			
Postage stamps and postage, ...	8	16	0			
Petty charges and incidentals, ...	6	7	6			
Total Contingencies, .				38	18	[illegible]
Coals, Gas, Etc.						
Alliance Gas Company, gas, ...	25	11	0			
Day, Mary, charcoal, ...	0	5	6			
Holmes, Thomas, coals, ...	21	5	0			
Forward,	47	1	6	1598	2	[illegible]

	£	s.	d.	£	s.	d.
Brought forward,	47	1	6	1598	2	0
Lambert, J., candles, ...	0	7	0			
Tharel, P., tapers, ...	0	1	6			
Total amount of Gas, Coals, &c. .				47	10	0
BOARD OF WORKS.						
Balance of Treasury Warrants, ...	. . . .			69	16	10
PHOTOGRAPHIC APPARATUS.						
J. Robinson, Camera, &c., ...	. . . .			10	15	0
Total Discharge, ...	. . . .			1726	3	10
Balance in favour of the Public,	. . . .			249	2	11
TOTAL AMOUNT OF CHARGE, . .	. . . .			1975	6	9

GENERAL ABSTRACT OF THE MONTHLY ACCOUNTS OF THE ROYAL IRISH ACADEMY,

AS FURNISHED TO AUDIT OFFICE, FROM 1st APRIL, 1855, TO 31st MARCH, 1856, INCLUSIVE.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance on 1st April, 1855,	82	10	1	By Books, Printing, &c.,	602	6	8
To Government and Treasury Allowance,	584	11	7	By Antiquities,	372	12	0
To Government Grant for Gold Ornaments,	160	0	0	By Taxes and Insurance,	27	4	8
To Interest on Stock,	78	14	2	By Repairs of House,	15	15	11
To Government Stock Sold,	464	19	5	By Furniture and Repairs,	189	9	6
To Transactions and Proceedings Sold,	14	8	6	By Salaries, Wages, &c.,	401	15	8
To Life Composition,	171	8	0	By Contingencies,	38	18	0
To Entrance Fees,	86	15	0	By Coals, Gas, &c.,	47	10	0
To Annual Subscriptions,	411	12	0	By Board of Works,	69	16	10
To Subscription to Gold Ornaments,	77	10	0	By Photographic Apparatus,	10	15	0
To Photographic Apparatus Sold,	2	15	0				
To Furniture Sold,	0	2	6		1726	8	10
To Contingencies,	0	5	6	By Balance,	249	2	11
	£1975	6	9		£1976	6	9

The Treasurer reports that there is to the credit of the Academy, in the Bank of Ireland, £1229 14*s.* 5*d.* in 3 per cent. Consols, and £1143 19*s.* 6*d.* in 3 per cent. New Stock. Total amount of Stock, £2373 18*s* 11*d.*, of which £1643 19*s.* 6*d.* is known as the Conyngham Fund.

31*st March*, 1856.

(Signed), ROBERT BALL,

Treasurer.

No. V.

ACCOUNT

OF

THE ROYAL IRISH ACADEMY,

FROM 1st APRIL, 1856, TO 31st MARCH, 1857.

THE CHARGE.

	£	s.	d.	£	s.	d.
To Balance in favour of the Public on 1st April, 1856 (see Ap. No. IV., p. lxv.),	.	.	. .	249	2	11
Parliamentary Grant, ...	.	.	. .	533	0	0
INTEREST ON STOCKS:						
One year's on £1143 19 6 at 3 per Cent.	34	6	4			
„ £1229 14 5 at 3 „ .	36	17	10			
Total Interest on Stocks, . .				71	4	2
TRANSACTIONS AND PROCEEDINGS sold:						
Rev. J. Alcorn, 5*s.*; Mr. Ferrar, 2*s.* 6*d.*; Mr. Geoghegan, 2*s.* 6*d.*; Mr. Gregg, 2*s.* 6*d.*; Mr. Highton, 2*s.* 6*d.*; Hodges & Smith, 12*s.* 5*d.*; Sir C. O'Loghlen, Bt., 5*s.*; Rev. J. H. Todd, D. D., 2*s.*; Mr. Warren, 2*s.* 6*d.*; Mr. M'Carthy, 1*s.*, ...	.	.	. .	1	17	11
LIFE COMPOSITIONS:						
Sir M. Barrington, Bart., ...	6	6	0			
Edward Cane, Esq., ...	6	6	0			
C. W. Hamilton, Esq., ...	6	6	0			
H. H. Joy, Esq., ...	6	6	0			
G. A. Kennedy, M. D., . . . 4 4 0						
Do. (from Annual Subscriptions) 2 2 0						
	6	6	0			
Rev. James M'Ivor, D. D., ...	21	0	0			
Rev. Edward Marks, D. D., ...	6	6	0			
C. Vignoles, Esq., ...	6	6	0			
Total Life Compositions, .				65	2	0
Forward,	.	.	. .	920	7	0

For 1855:—

Sir Matthew Barrington, Bart
D. J. Corrigan, M. D.; Rev. R
Esq.; Sir Chas. Fox, Bart.; J
G. Melville, M. D.; J. S. Mus
Esq.; Thomas Oldham, Esq.;

For 1856:—

Rev. I. G. Abeltshauser, LL.
Rev. J. Alcorn; W. Andre
LL. D.; A. W. Baker, Esq.
E. Barnes, Esq.; Sir M. Bar
Beauchamp, M. D.; P. Beva
M. D.; D. F. Brady, M. D.; D
B. Cane, Esq.; E. Cane, Esq
Clarendon, Esq., A. B., C. E.
E. S. Clarke, M. D.; A. Cooke,
M. D.; Ven. Archdeacon of C
J. Davidson, Esq.; R. Deasy, I
Dixon, A. M.; Viscount Dun
M. D.; J. S. Eiffe, Esq.; Lor
Fleming, M. D.; Capt. G. A.
Rev. J. A. Galbraith; E. Getty,
S. Gordon, M. D.; Very Rev.
A. M.; D. Griffin, M. D.; W.
Grubb, Esq.; C. W. Hamilto
cock, LL. D.; C. Hanlon, Esq
Esq.; Rev. S. Haughton, A. M.;
Sir John K. James, Bart.; Rev

	£	s.	d
Brought forward.	988	12	0
M'Clintock, M. D.; J.S. Macdonnell, Esq.; R. R. Madden, M. D.; J. Magee, Esq.; A. G. Melville, M. D.; G. M. Miller, Esq.; J. Mollan, M. D.; D. Moore, Esq. J. S. Muspratt, Esq.; J. M. Neligan, M. D.; P. Neville, Esq.; J. R. O'Flanagan, Esq.; M. M. O'Grady, M.D.; T. Oldham, Esq.; J. Osborne, M. D.; J. Owen, Esq.; J. Patten, M. D.; J. E. Pigot, Esq.; J. B. Pratt, Esq.; A. Preston, Esq.; A. Read, M.D.; G. Sanders, Esq.; O'N. Segrave, Esq.; F. J. Sidney, LL.D.; R. W. Smith, M. D.; H. Smyth, Esq.; M. H. Stapleton, M. B.; D. P. Starkey, Esq.; H. H. Stewart, M. D.; R. Tighe, Esq.; J. F. Waller, LL. D.; Right Hon. J. Wynne; G. Yeates, Esq. (£205 16*s.*)			
For 1857:—			
R. Adams, M. D.; Sir J. B. Burke; J. Burrowes, Esq.; Very Rev. Dean of Clonmacnoise; A. B. Cane, Esq.; A. Carte, M. B.; F. Churchill, M. D.; A. Cooke, Esq.; C. Copland, Esq.; Lord Bishop of Cork; Ven. Archdeacon of Cashel; E. W. Davy, A. B.; M. Donovan, Esq.; S. Downing, LL. D.; Viscount Dungannon; C. Fleming, M. D.; L. E. Foot, Esq.; E. Getty, Esq.; W. N. Hancock, L.L. D.; C. Hanlon, Esq.; W. H. Hardinge, Esq.; Lieut.-Col. H. James; F. M. Jennings, Esq.; J. C. F. Kenny, Esq.; Lord Bishop of Kilmore; C. C. King, M. D.; T. H. Ledwich, Esq.; F. L'Estrange, Esq.; W. R. Le Fanu, Esq., C. E.; A. J. Maley, Esq.; A. R. Nugent, Esq.; J. O'Donovan, LL. D.; R. Patterson, Esq.; G. Roe, Esq., D. L.; Lord Talbot de Malahide; Ven. Archdeacon of Dublin. (£75 12*s.*)			
Total Annual Subscriptions, .	306	12	0
CONTINGENCIES.			
A. Cane, 2*s.*; Royal Dublin Society, 2*s.* 6*d.* . . .	0	4	6
SUBSCRIPTIONS TOWARDS THE PURCHASE OF GOLD ORNAMENTS FOUND IN CO. CLARE.			
Rev. J. A. Galbraith, ... £1 0 0			
Rev. Charles Graves, D. D., ... 5 0 0			
Total Subscriptions for Gold Ornaments, ...	6	0	
TOTAL AMOUNT OF CHARGE, ...	1301	8	

THE DISCHARGE.

		£ s. d.	£ s. d.
Antiquities Purchased, Etc.			
Carey, J., gold ornament, 4th December,		25 0 0	
Egan, D., dagger, 3rd July, ...		0 10 0	
Glennon, R., collection found in river Brusna, 29th November, ...		15 0 0	
Johnson, J., repairs of do., 13th December,		0 10 0	
Kelly, T., iron pot, 7th July, ...		0 10 0	
O'Donnell, Jas., brass vessel, 5th January,		1 0 0	
Rourke, F. A., do., 19th April, .		0 10 0	
Wakeman, W. F., collection, 19th June,		3 0 0	
Total Antiquities purchased, ...			46 0 0
Books, Printing, and Stationery.			
Barthes & Co., Gailhabaud's Monuments, . £10 10 0			
Ditto, Table des MM. de l'Acad. des Inscriptions, 1 5 0	11 15 0		
Carroll, P., April, £1 5*s.*, 2*s.*; May, 2*s.*; June, 3*s.* 6*d.*, 4*s.*, 5*s.*, 15*s.*, 17*s.* 6*d.*; July, 17*s.* 6*d.*; Sept. 1*s.*, 2*s.* 6*d.*; Dec. 3*s.*; Jan. £1 3*s.* 6*d.*; Feb. 3*s.*; March, 1*s.* 4*d.*, 3*s.* 6*d.*, ...	6 9 4		
D'Alton, J., ...	0 10 0		
Evans, pamphlets, ...	0 4 4		
Fottrell, L., Reports British Association, ...	0 16 0		
Gallagher, James, Thom's Directory,.	0 13 6		
Hodges and Smith, books, &c.,	31 15 0		
Jones, J. F. (J. Hardiman's books), ...	35 5 3		
——— Ferguson's books,	16 15 3		
——— Miscellanies, May, 5*s.*; June, 10*s.* 6*d.*; Jan. £5 5*s.*, £8 19*s.*; Mar. 15*s.*,	15 14 6		
Kelly, W. B., April, 10*s.*; December, £2 3*s.* 6*d.*, .	2 13 6		
Forward,	122 11 8	. . . . .	46 0

		£ s. d.	£ s. d.	£ s. d.
Brought forward,		122 11 8	. . . . .	46 0 0
M'Grane, W., May, 5*s.*, 7*s.*; April, 6*s.*; June, 3*s.*, 8*s.*, 13*s.*; Sept., 2*s.*; Dec. 3*s.*; Jan. 12*s.*; March, 1*s.*, . .		3 0 0		
Paleontographical Soc., subscription to, from 1847 to 1856, inclusive (ten years), . .	10 10 0			
Carriage of books,	0 4 6			
		10 14 6		
Ray Society, subscriptions for 1855, 1856, ...		2 2 0		
Tighe, P., book,.		0 10 0		
Total printed books, . . .			138 18 2	
J. F. Jones (J. Hardiman's MSS.), ...		. . . . .	72 1 0	
Carroll, B., 2 early vols., Transactions, ...		. . . . .	0 5 0	
PRINTING PROCEEDINGS.				
M. H. Gill, printing vol. vi. part 3, ...		61 6 4		
Hanlon, G. A., woodcuts, March, ...		1 0 0		
Oldham, W., for Mr. Sanders' Paper (gas meter), . . .		1 4 0		
Short, W., reporting Mr. Kemble's Address, ...		1 1 0		
Total Printing Proceedings,			64 11 4	
PRINTING TRANSACTIONS.				
M. H. Gill, printing Transactions, vol. xxii. part 1, Mr. Haughton's Paper, . . .		91 1 1		
——— Mr. Donovan's Paper,		14 15 7		
——— Mr. Mallet's Paper, .	198 0 5			
Falkner, J., lithographs for ditto,	25 10 0			
Mallet, R., electrotype for ditto, .	0 19 4			
Forward, . .	224 9 9	105 16 8	275 15 6	46 0 0

	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Brought forward,	224	9	9	105	16	8	275	15	6	46	0	0
Oldham, William, woodcuts for do.	15	0	0									
Mallet, R., carriage of lithographs for ditto,	0	8	0									
Cost of Mr. Mallet's paper, . . .				239	17	9						
Oldham, W., woodcuts for Mr. Downing's Paper, . .				2	15	0						
"Freeman's Journal,"	0	5	6									
Johnson and Co.,	4	18	6									
Cost of Advertising,				5	4	0						
Total Printing Transactions,							353	13	5			
Stationery, Etc.												
Brown and Co., blank book,				0	4	8						
Carroll, B., gum Arabic, 5*s.* 6*d.*; six portfolios, 15*s.*; paper, 7*s.* 6*d.*; paper, 4*s.*; portfolios, £1 15*s.* 7*d.*, ...				3	7	7						
Ferrier and Co. lapping paper,				1	8	4						
Jackson, J., ink, quills, pens,				2	8	3						
Tallon, J., stationery, . . .				3	0	1						
Woodhouse, W., book stamp,				0	10	0						
Yeates, Geo., paper-cutters, &c., Nov., ...				1	6	0						
Cost of Stationery, ...							12	4	11			
Library Catalogue.												
Tighe, James, 27 weeks, ...							27	0	0			
Total Books, MSS., Printing, and Stationery, &c.										668	13	10
Taxes, Insurance, Etc.												
Boyle, Low, and Co., income tax on dividends, to Jan. 1, 1856, ...							4	14	11			
National Insurance Company, December, .							10	6	0			
Patriotic Insurance Company, December,							6	3	6			
Parish cess for 1856, ...							0	4	8			
Pipe-water tax for 1856, ...							2	17	8			
Total Taxes and Insurances, ...										24	6	9
Forward,							. . . . .			739	0	[illegible]

	£	s.	d.	£	s.	d.
Forward,	. .	. .	.	739	0	7
Repairs of House.						
Bray, J., cleaning ash-pit, ...	1	10	0			
Boylan, J., cleaning windows, ...	0	17	9			
Carroll, J., cleaning chimneys, ...	0	19	0			
Cassidy, F., cleaning windows, ...	0	6	0			
Giblin, repairs of gallery in library, . .	1	0	0			
Maguire, J., sundries, ...	2	18	1			
Mooney, W., gas fittings, ...	1	3	9			
Murphy, J. sweeping chimneys, . . .	1	2	0			
Yeates, G., repairs of pump, November, .	0	7	6			
Total Repairs of House, ...				10	4	1
Furniture and Repairs.						
Browne and Co., velveteen, &c., . . .	0	18	4			
Carroll, B., busts, ... £1 10 0						
chest, ... 1 0 0						
stand, ... 1 0 0						
busts, ... 3 10 0						
	7	0	0			
De Vaux, H. J., silk, &c., ...	0	3	5			
Dobbyn, Geo., clock in Library, October,	7	0	0			
Hall, R., cleaning carpets, ...	1	2	6			
M'Grath, J., black marble slab, . . .	0	3	6			
West and Co., 6 Bristol pans, ...	0	7	0			
Wiseheart and Son, blue paper, . . .	0	4	0			
Pike, W., fender, tin boxes, ...	3	9	0			
Pim, Brothers, oil-cloth, ...	2	18	6			
Total Furniture and Repairs, ...				23	6	3
Salaries, Wages, Etc.						
Ball, Robert, LL. D., Treasurer, . . .	21	0	0			
Drummond, Rev W. H., D.D., Librarian,	21	0	0			
Graves, Rev. Chas., D. D., Secretary to the Academy, ...	21	0	0			
Clibborn, E., Clerk, and Assistant Librarian and Curator of Museum	150	0	0			
Todhunter, Isaac, Accountant, ...	60	0	0			
Kelly, Arthur library and house porter,	39	0	0			
Leigh, Simon, porter and messenger, . .	39	0	0			
O'Neill, E., for cleaning house, ...	0	18	6			
Armstrong, Jane, do., ...	9	0	0			
Lockett, livery for servants, ...	13	0	0			
Total Salaries, Wages, &c., ...				363	13	6
Forward,	. .	. .	.	1136	4	5

	£	s.	d.	£	s.	d.	£	s.	d.
Brought forward,				. . . .			1136	4	5
Contingencies.									
Steam Packet Co., parcels,	1	7	3						
Elliott, J., ditto,	0	2	8						
Royal Dublin Society, ditto,	0	2	8						
Railway Company, ditto,	0	4	0						
Cross, J. S., ditto,	0	6	6						
Barthes and Co., ditto,	7	4	10						
Amount of Carriage, Books, &c.,				9	7	11			
Boyle and Co., commission on receiving dividends,				0	5	0			
Postage stamps and postage,				8	15	0			
Johnson, J., oil of cloves, &c.,				0	5	5			
Wiseheart, J., paper,				0	2	0			
Tallon, J., stamps for receipts,				0	16	8			
Wallace, W. B., bill of law costs,				4	8	4			
Todhunter, J., car hire,				0	1	0			
Clibborn, E., allowance for sundries used in cleaning house, for the year 1856-57,				10	0	0			
Total Contingencies,							34	1	4
Coals, Gas, Etc.									
Brown, George, safety lights,				0	8	6			
Holmes, T., 11 tons Whitehaven coal,				9	11	6			
Tedcastle, Robt., 30 tons Carlisle coal,				24	15	0			
Alliance Gas Company, coke,				0	12	9			
Do., gas from 31st Dec., 1855, to 30th Sept., 1856,				18	19	2			
Cosgrave, James, fire-wood,				0	13	0			
Keenan, J., bog-wood,				0	10	0			
Lambert, J., candles,				0	12	3			
Total Coals, Gas, &c.,							56	2	2
Catalogue of Museum.									
Dillon, L. W., paint, &c.,				0	4	0			
M'Loughlin, J., one day,				0	2	6			
Boswell, J., 1 doz. flock paper,	0	14	0						
——— 10 doz. green do.,	1	0	0						
				1	14	0			
Maguire and Co., wire netting, &c.,				2	9	0			
Maguire, J., preparing trays,				0	15	0			
Total Catalogue of Museum,							5	4	6
Total Discharge,				. . . .			1231	12	5
Balance in favour of the Public, per this Account,				. . . .			69	16	1
Total Amount of Charge,				. . . .			1301	8	6

GENERAL ABSTRACT OF THE MONTHLY ACCOUNTS OF THE ROYAL IRISH ACADEMY,

AS FURNISHED TO AUDIT OFFICE, FROM 1ST APRIL, 1856, TO 31ST MARCH, 1857, INCLUSIVE.

Dr.	£	s.	d.	Cr.		£	s.	d.
To Balance on 1st April, 1856,	249	2	11	By Books, Printing, &c.,		663	1	10
To Government Grant,	533	0	0	By Antiquities,		45	10	0
To Interest on Stock,	71	4	2	By Taxes and Insurance,		24	6	9
To Entrance Fees,	68	5	0	By Repairs of House,		10	14	1
To Life Composition,	63	0	0	By Furniture and Repairs,		23	14	9
To Annual Subscriptions,	308	14	0	By Salaries, Wages, &c.,		363	13	6
To Subscription to Gold Ornaments,	6	0	0	By Coals, Gas, &c.,		55	13	8
To Transactions and Proceedings sold,	1	17	11	By Contingencies,		39	13	4
To Contingencies,	0	4	6	By Catalogue of Museum,		5	4	6
						£1231	12	5
				In Bank of Ireland,	£67 17 5			
				In Treasurer's hands,	1 18 8			
				By Balance,		*69	16	1
	£1301	8	6			£1301	8	6

The Treasurer reports that there is to the credit of the Academy, in the Bank of Ireland, £1229 14*s.* 5*d.* in 3 per cent. Consols, and £1143 19*s.* 6*d.* in 3 per cent. New Stock. Total amount of Stock, £2373 13*s.* 11*d.*, of which £1643 19*s.* 6*d.* is known as the Conyngham Fund.

31*st March*, 1857.

(Signed), JOSEPH CARSON, D.D.,

Treasurer.

* The Commissioners for Auditing Public Accounts, by their note of the 23rd June, 1857, added £300 to this Balance, by "a disallowance on preceding account" of "£300," paid Mr. James West on 17th March, 1856, *on account of Gold Antiquities found in the county of Clare* (see Proceedings, vol. vi., App. p. lxi.), and deposited in the Academy. This sum remains in suspense until the exact quantity of the Antiquities which can be retained is ascertained.